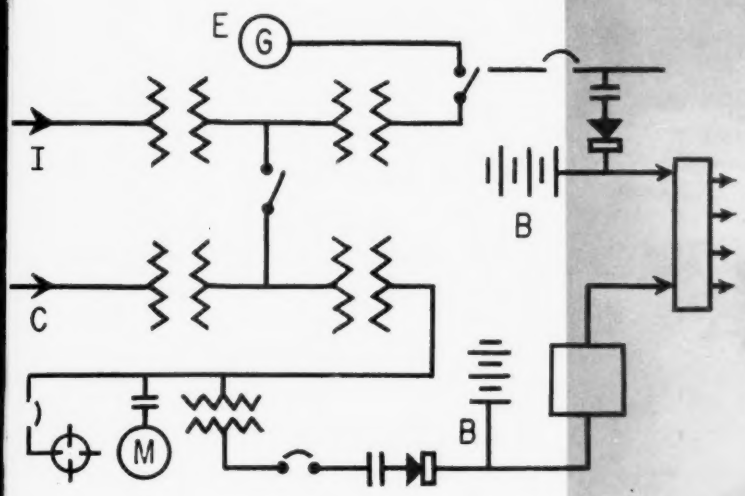
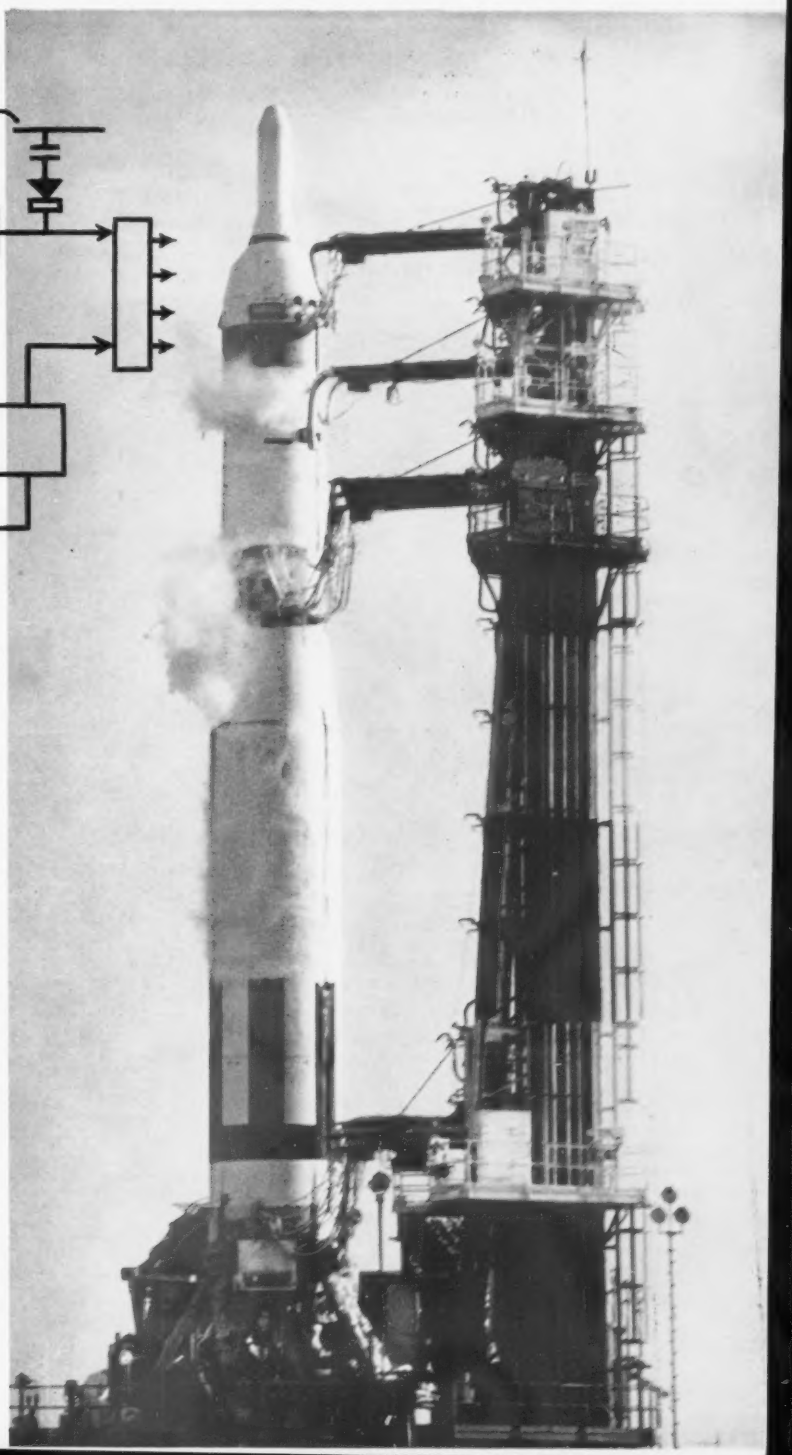
AUGUST
1961

PRICE 75 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING





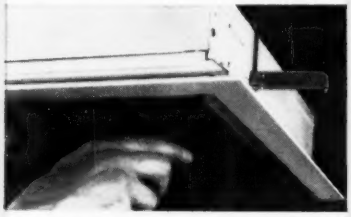
ELECTRICAL POWER BACKUP

Multiple sources of interrupted electric power are used for precisely scheduled missile launching procedures.

A McGRAW-HILL PUBLICATION | 60TH YEAR

GUTH saves up to 50% on Troffer installation*

Swing Mounting Bracket is preset for height of ceiling support members by adjusting single screw.



Release SMB by tripping clip from inside troffer. It's ready to hook over support.

Adjust screw to draw up troffer trim flush with ceiling. The job is done!

NEW SHALLOW MODELS WITH CBM/ETL BALLASTS, SEPARATELY FUSED

with NEW SMB swing mounting brackets

New Guth Troffers feature Swing Mounting Brackets to simplify installation...**plus** a complete variety to fit most every specification requirement!

New 4¾" shallow models come in 2′ and 4′ widths. Other units in 6" and 12" widths . . . 2′, 4′ and 8′ lengths. Almost any bottom you can name — including GrateLite Louver Diffuser** and Prismoid GrateLite†. Adaptable to nearly every type of ceiling suspension system.

*These savings do not include wiring and final connections and are based on installation in a plaster or concealed suspension system.

ASK FOR GUTH SMB TROFFER BULLETINS!

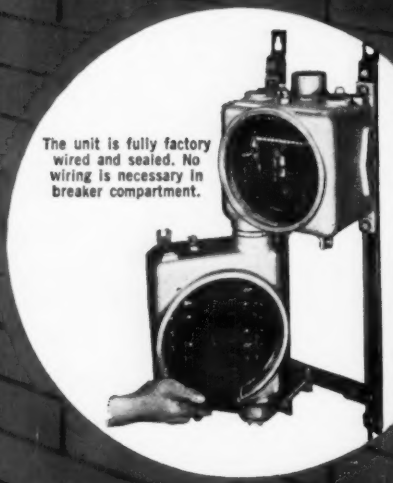
THE EDWIN F. GUTH CO. 2615 WASHINGTON BLVD. • BOX 7079, ST. LOUIS 77, MO.

Guth LIGHTING since 1902

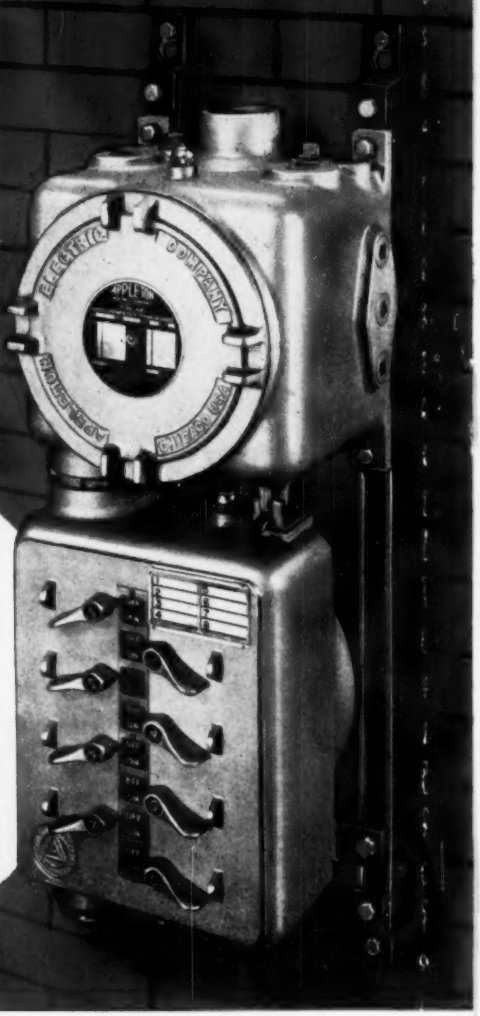
**® U. S. PAT. NO. 2,745,001 CAN. PAT. NO. 538,245 †® U. S. PAT. NO. 2,904,673

"NEW ESP" ECONOMY SERIES

NEW "EDP" WITH EXCLUSIVE APPLETON ENGINEERING FEATURES



The unit is fully factory wired and sealed. No wiring is necessary in breaker compartment.



NEW APPLETON®

EXPLOSION-PROOF PANELBOARDS

EDP represents an entirely new, distinctive engineering advance in panelboard design.

EDP features a unique exclusive PIVOT between junction and breaker housing. This is the *Key* to Compact Size, Plug-In "E" Frame Breakers, Easier, more Convenient Installation, Quicker Main and Branch Wiring and Simplified Maintenance.

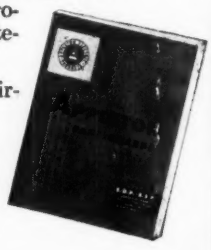
APPLETON EDP panelboards are engineered to handle motor control, machinery, alarm, lighting and a wide range of circuits requiring breaker capacities of 15, 20 or 30 amperes. They are available for 4 to 24 single pole, 2 to 12 double pole and 2 to 8 three pole circuits in various wiring systems.

Field wiring consists of connecting main and branch lines to pressure type terminals. Terminal boards are numbered for easy identification.

NEW ESP ECONOMY SERIES

ESP is compact, rugged, dependable and low cost. It embodies many unique features that provide easy installation, convenient maintenance, maximum safety and long life.

ESP is available for four single pole circuits, or two double pole circuits.



Twenty-eight page fully illustrated and detailed catalog is just off the press. Write for your copy now. Bulletin 661.

APPLETON® electric company

1701 Wellington Avenue, Chicago 13, Illinois

ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The Electrogist and Electrical Record . . . Established 1901

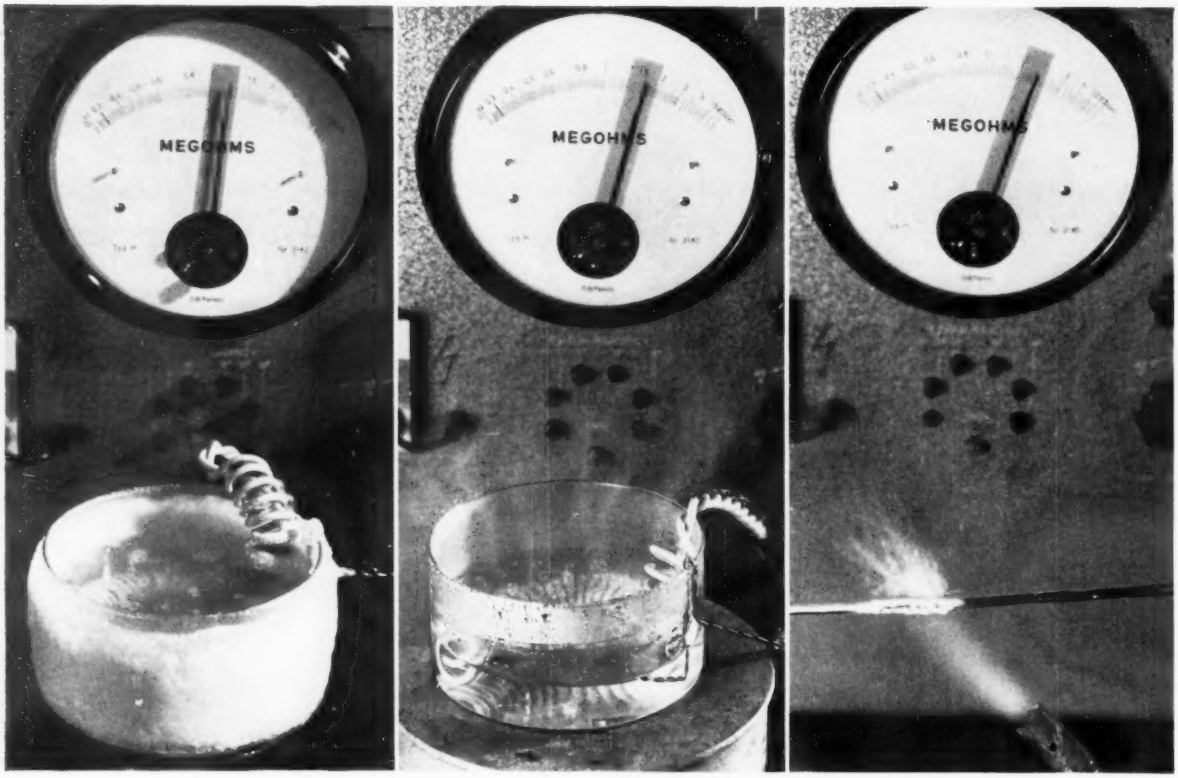
Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

60TH YEAR • AUGUST 1961

MORE

SILICONE NEWS from Dow Corning

Frozen...boiled...burned

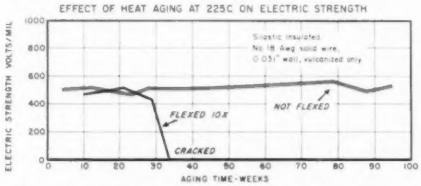


Silastic insulation maintains its properties from −90 to 500 F.

When mercury freezes, Silastic®, the Dow Corning silicone rubber, is still flexible. Fact is, Silastic insulation is ideal for temperatures as low as −90 F . . . easily withstands sleet, snow, ice and adverse weather you'd expect to find in the polar regions.

In a hot stew? Specify Silastic! Even 500 F has little effect on the properties of Silastic. That's why many industrial plants use Silastic insulated wire and cable. Strip mills, rolling mills, and metal forming plants (where high temperatures, humidity, chemical splash and fumes are common environments) are but a few of the installations using the properties of Silastic to provide cable dependability and long life.

To air-condition Hades would be a rugged assignment. However, if you were engineering the job you should specify power cables insulated with Silastic. Even if the Silastic burns, the ash is nonconductive. The line can carry a normal load as long as the ash remains intact and dry. This unique property of Silastic has been of primary importance in the protection of vital communication centers in both Navy shipboard and commercial installations.



Silastic insulation retains dielectric strength over a wide temperature span. What's more, its electrical properties are extremely stable and survive relatively unchanged even after long storage, weathering, thermal aging or heat cycling.

Write Dow Corning Corporation, Midland, Michigan, Dept. 3620, for a list of wire and cable manufacturers who use Silastic.

first in silicones

Dow Corning

ELECTRICAL CONSTRUCTION AND MAINTENANCE

AUGUST • 1961 *continued*

Vol. 60, No. 8 ELECTRICAL CONSTRUCTION and MAINTENANCE AUGUST 1961

Published monthly with an additional issue in September by McGraw-Hill Publishing Company, Inc. James H. McGraw (1860-1948), Founder. Executive, Editorial, Circulation and Advertising Offices: **McGraw-Hill Building, 330 W. 42nd St., New York 36, N.Y.** Printed in Albany, N.Y. **Officers of the Publications Division:** Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator, Daniel F. Crowley, Vice President and Controller. **Officers of the Corporation:** Donald C. McGraw, President; Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Executive Vice President and Treasurer; John J. Cooke, Vice President and Secretary.

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United States subscription rate for individuals in the field of the publication $3.00 per year. This issue 75 cents. Electrical Products Guide $2.50. Canada $5.00 a year. All other countries, $15.00 a year, payable in advance. Second class postage paid at Albany, N. Y., and at additional mailing offices. Printed in U.S.A. Title registered in U.S. Patent Office.

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Make UNIFORM OFFSETS in 1/2" E.M.T. in 2 SECONDS

with NEW Greenlee No. 1810 "Little Kicker"

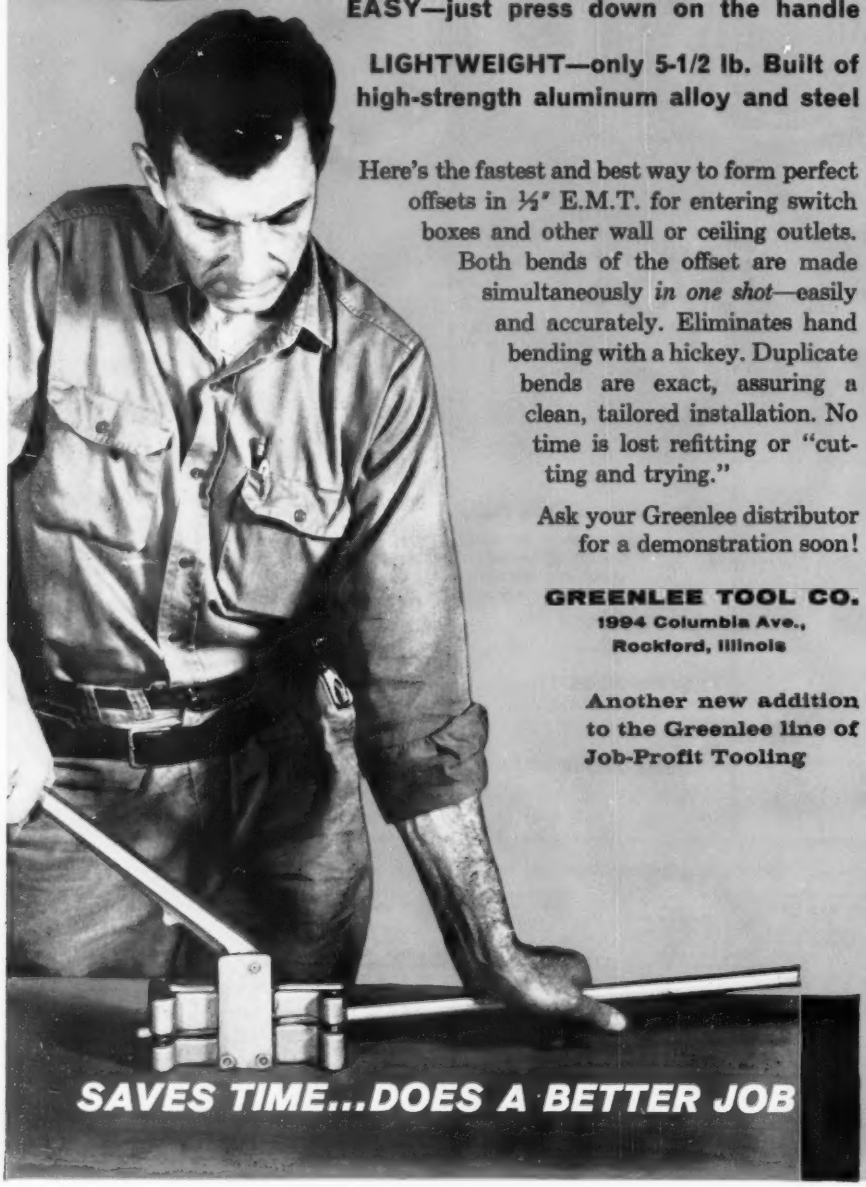
GREENLEE

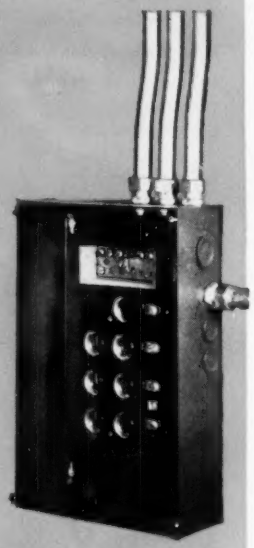
FAST—makes complete offset in one shot

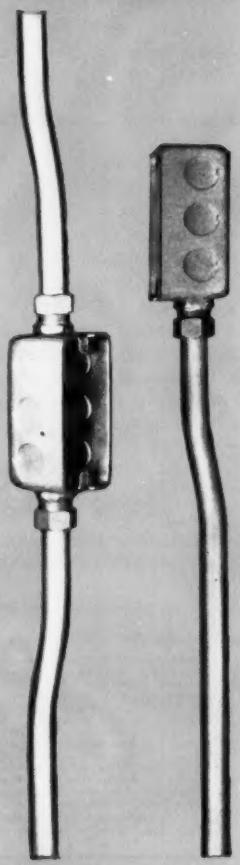
ACCURATE—every bend is identical

EASY—just press down on the handle

LIGHTWEIGHT—only 5-1/2 lb. Built of high-strength aluminum alloy and steel







Here's the fastest and best way to form perfect offsets in ½" E.M.T. for entering switch boxes and other wall or ceiling outlets. Both bends of the offset are made simultaneously *in one shot*—easily and accurately. Eliminates hand bending with a hickey. Duplicate bends are exact, assuring a clean, tailored installation. No time is lost refitting or "cutting and trying."

Ask your Greenlee distributor for a demonstration soon!

GREENLEE TOOL CO.
1994 Columbia Ave.,
Rockford, Illinois

Another new addition to the Greenlee line of Job-Profit Tooling

SAVES TIME...DOES A BETTER JOB

Sidelights

POWER FOR MISSILES

Electrical systems required for launching missiles and space vehicles are elaborate complexes of power, control and communication circuits. During and after the "countdown" electrical power continuity is vital and even momentary interruptions cannot be tolerated. Power backup comes from multiple sources to assure complete reliability during the critical periods. Associate Editor Berlon C. Cooper visited the famous Cape Canaveral installation to study the electrical systems involved and to bring us a report on the methods employed. His article, "Electrical Power Backup Aids Missile Launching," opens our feature section this month beginning on page 77.

THEY SELL LIGHTING MAINTENANCE

Salesladies are doing an effective job of selling lighting maintenance service for Krug Maintenance Co., Inc. of Brooklyn, N. Y., and the feminine touch is a definite asset with customers and prospects, according to Herbert Wohlman, manager of Krug's lighting division. The young women on his sales force are carefully trained and handle many of the technical problems they encounter with only an occasional assist from the engineering staff. Operation of the novel sales organization is described in "Salesladies for Lighting Maintenance" beginning on page 90.

CONTRACT MAINTENANCE

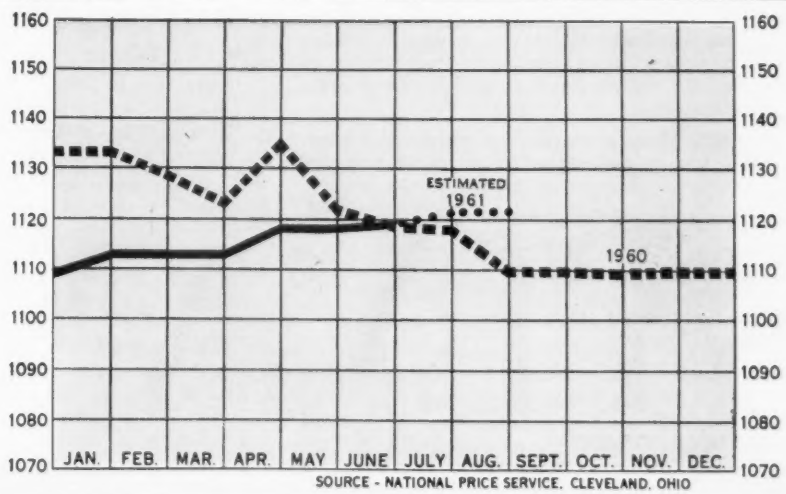
In the third article in his current series on industrial electrical maintenance practice, Assistant Editor Robert J. Lawrie reports on a Newark, N. J., brewery where electrical maintenance is handled through contract with outside contractors who supply and supervise a 20-man force of skilled electricians. As in previous articles in the series, Mr. Lawrie develops his report through a personal interview with the key personnel involved in the direction of the work. "Electrical Maintenance by Contract" begins on page 84.

CHECKING POWER FACTOR

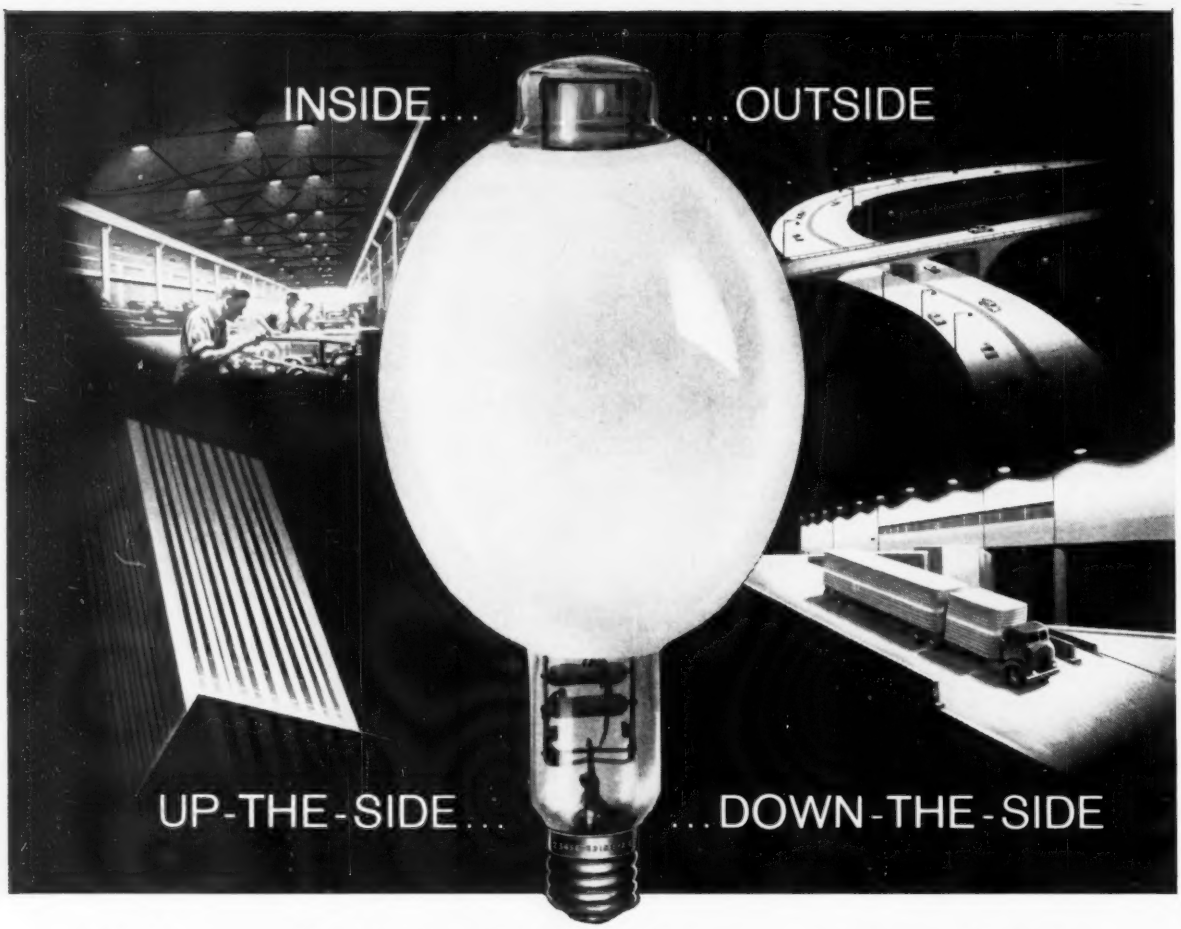
Investigations of power factor conditions on individual equipment or portions of the power system are often required. A convenient and useful method of determining load power factor employs two wattmeters and a "ratio of wattmeter readings" curve. R. C. Moore, Motor and Generator Department, Allis-Chalmers Mfg. Co., describes the method and its application in the article "Determining Power Factor from a Graph" beginning on page 92.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



SOURCE - NATIONAL PRICE SERVICE, CLEVELAND, OHIO



Only new Sylvania Banner Mercury Lamps deliver all these advantages for indoor-outdoor lighting:

1. Longer life! Now extended to 12,000 hours. With greater maintained brightness giving a dividend of *17% more light during life* than standard mercury lamps.

2. More light! Almost triple the light of incandescents on the same power! Makes Banner Mercury Lamps ideal for street lighting, facades, industrial installations.

3. Ruggedized construction! Shocks, vibrations, fiercest weather don't stand a chance. Hard glass shell protects on the outside; welded multiple supports, springs protect on the inside, assure longer life.

4. Life recording base! Unusual feature saves time, paper work by letting you scratch installation date in numbers right on base of lamp.

5. Certified Performance Policy guarantees: "Banner Mercury Lamps may be returned to the supplier for full exchange if they fail in less than 1000 burning hours, and thereafter (up to 5000 hours) for pro-rata exchange, in accordance with a pro-rata exchange value table set forth clearly in the policy form."

PLUS Lowest TCL (Total Cost of Lighting), which means cost of lamps plus power plus maintenance. Get the most light for your money. Call your Sylvania representative. Or write: Lighting Division, Sylvania Electric Products Inc., Dept. 42b 60 Boston St., Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., Montreal.

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Washington Report

AUGUST • 1961

The nation's economic activity is at a new high, with its output of goods and services (Gross National Product) having reached a record annual pace of $515 billion in the second quarter. The previous quarterly high was an annual rate of $506.8 billion in the second quarter of 1960. The second quarter rate was nearly $15 billion, or 3% above the first quarter annual rate of $500.8 billion. Other highlights of the business climate include:

- **Industrial output** in June increased to a near record of 110% of the 1957 average, 8% above the recession low, and only 1% below the record FRB Index of 111, hit in January 1960.
- **Personal income** set a record annual rate of $416.7 billion, seasonally-adjusted, in June, or $3.5 billion over the May annual rate.
- **Employment** hit a new high in June, at 68.7 million.
- **Housing starts** in June rose to a seasonally-adjusted annual rate of 1,374,000, highest annual rate for 16 months.
- **Retail sales** reached a 7-month high of $18.3 billion, up 1% from May. The record is $18.9 billion, reached in April 1960.

On the debit side, unemployment remains at a disturbing 5,600,000, or about 6.8% of the labor force. Also, the 1961 Federal budget, for the fiscal year ended June 30, 1961 showed a deficit of $3.9 billion. Federal spending in fiscal 1961 totaled $81.5 billion, and revenues totaled $77.6 billion. The Administration expects another deficit of $3.7 billion for the fiscal year ending June 30, 1962, exclusive of recent expansion of defense and space spending plans.

The Business Advisory Council severed its ties with the Department of Commerce last month, and reorganized as a private group under the name of the Business Council. Its membership, made up of business executives, remains unchanged. The BAC, which had given their time and opinions to Secretaries of Commerce over the past 28 years, would not accept the "tighter controls" imposed on its operations by the current Commerce Secretary Luther H. Hodges. The new Business Council has offered its services to any department of the government.

Civil defense is being viewed with new urgency, and President Kennedy is considering a greatly stepped up defense effort. Under an executive order effective August 1, the President transferred to the Defense Department responsibility for civil defense under and after enemy nuclear attack. Involved will be considerably increased funds for civil defense, particularly for atomic fall-out shelters.

Construction spending in June hit an annual rate of $56.5 billion, seasonally adjusted, the highest rate for 22 months. The actual total was $5,160 million, with $3,469 million for private funds, and $1,651 million for public funds. Public works continued to set the pace, at an annual rate of $17.4 billion, or 10% over a year earlier. Privately financed construction was at an annual rate of $39.1 billion, or 8% over a year earlier.

The outlook for homebuilding is improving. Housing starts in June were 136,900, or a seasonally adjusted annual rate of 1,374,000, the highest rate for 16 months, and 7% greater than in June 1960. The Commerce Dept's mid-year forecast put housing starts for the year at 1,275,000, or 3% above the 1960 total.

ROLL CALL!

Check The Record

☐ More miles in use underground than any other fibre conduit. ☐ oldest installations ☐ some go back 60 years and are still going strong. ☐ wide acceptance... ☐ by power and light utilities ☐ by telephone companies ☐ general contractors ☐ industry ☐ also by cities and municipalities ☐ first fibre conduit—we introduced it in 1893. ☐ first C. A. Conduit (coupling attached) ☐ first Klean-Kote for cleaner handling.

When anyone pays us the compliment of calling some other make of fibre conduit "orangeburg type" please remember that "orangeburg type" does not mean Orangeburg Brand Fibre Conduit. That's the brand and quality made by us alone.

Vital electrical cables deserve the best protection and we have spent nearly 70 years trying to make Orangeburg Brand Fibre Conduit the best that money can buy.

"No substitute is as good as the regular" it tries to replace.

KLEAN-KOTE*

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Orangeburg Manufacturing Co., Orangeburg, New York. Division of The Flintkote Company, Manufacturer of America's Broadest Line of Building Products
Orangeburg Klean-Kote is distributed by Graybar Electric Company and General Electric Supply Company with Branches and Stocks in Principal Cities.

Together, fellow fasteners, we can build an empire!

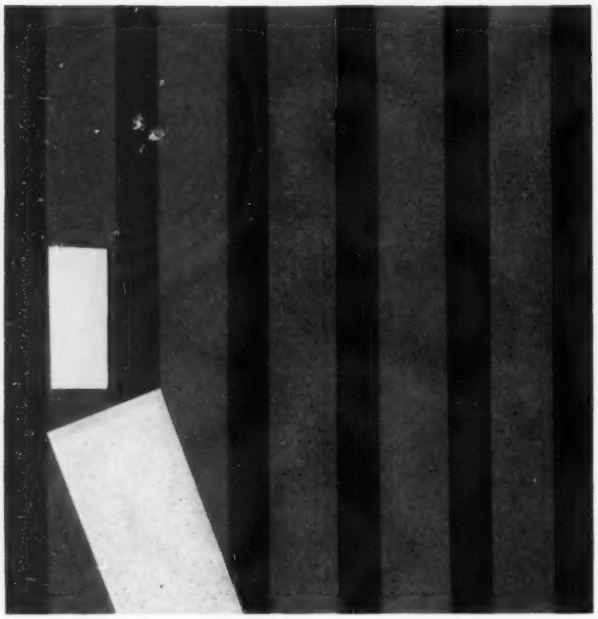
There are 125 different kinds of us, all strong and true and ready to carry our share of the load! We're powder-actuated and we mean business. We have threaded studs and drive pins (super-nails!). There's tall ones, short ones, in-between ones; there's fat ones and there's lean ones. Every last one of us can ram home into steel or concrete with ease. One every *fifteen seconds*. We can attach things down on, up against and suspended from. With our eyepins the Hanging Gardens of Babylon would still be hanging! We're the kingpins. We're the elite. We're austempered, to a man. A tougher group you'll never find. So give us a chance, that's all. Give us a chance and by the George Washington Bridge we'll build you an empire!

Our dealers are assistant empire-builders, but they're listed in The Yellow Pages under TOOLS. Talk to them about *your* empire. (Among other things, they'll tell you why we have red tips.)

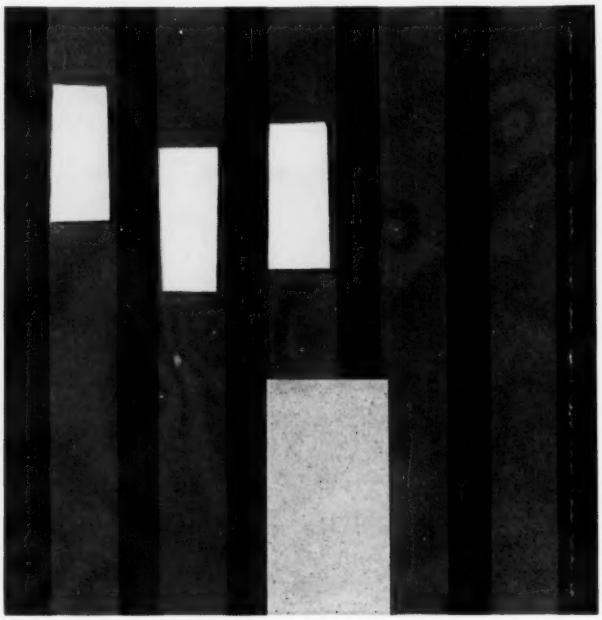
Ramset®

285-H **Winchester Ave., New Haven 4, Conn.** WINCHESTER-WESTERN DIVISION **Olin**

How the Westinghouse De-ion® Arc Chute

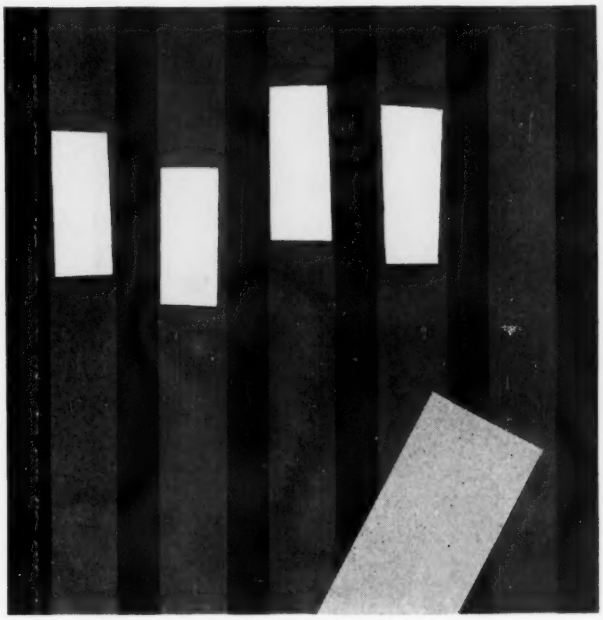


ARC FORMED on interrupting

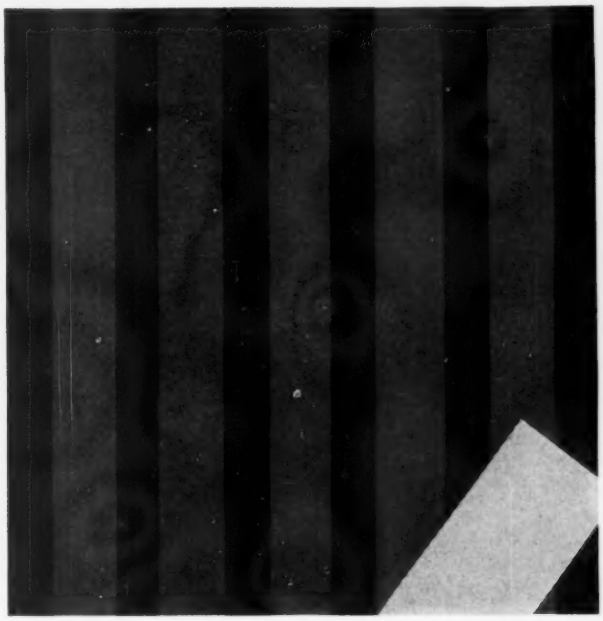


CONFINED within grid plates of quencher

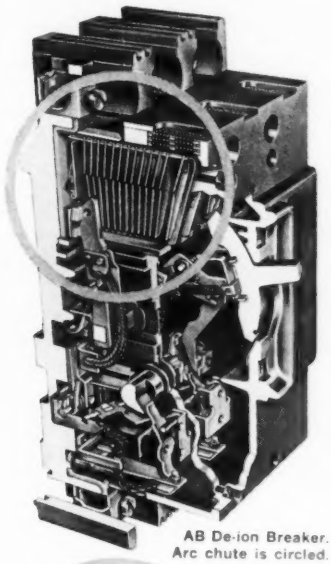
extinguishes breaker arcs in ½-cycle or less!



DIVIDED into small, harmless segments



EXTINGUISHED by the mass of grid plates



AB De-ion Breaker. Arc chute is circled.

Every time you break an electric circuit, an arc is formed. This arc must be controlled quickly and safely to protect the system. The finest and safest device to control arcs is the DE-ION® arc quencher in *all* Westinghouse AB circuit breakers.

The design of the chamber confines the arc and quenches it by dividing it into small harmless segments which are cooled and extinguished by the mass of surrounding material. The action within the arc chute is quick and positive.

See the quenching action in full color in Westinghouse's "Arc in Action" high speed photography flip book. It's free . . . ask your Westinghouse representative for a copy of SA-8900 or write: Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. *You can be sure . . . if it's Westinghouse.*

J-30327

Westinghouse

EASIEST TO USE BUILT-IN WRENCH

IDEAL WING-NUT

easiest to use--
built-in wrench

A twist of your wrist makes a perfect wire splice with a Wing-Nut. You don't need tools—even on the toughest branch circuit wires.

Unique wings provide a natural grip. Because of the leverage with this "built-in" wrench, Wing-Nut is twice as easy to apply as other connectors. Internal spring tension makes the splice tight. The only way Wing-Nut will come off is for *you* to remove it.

You can actually see your splice through the semi-transparent Nylon shell, the strongest used on any connector. And the wide, deep Wing-Nut skirt slips easily over a wire combination as large as two No. 8 and a No. 6, even thick type RW insulated wire. In crowded boxes just clip the wings off after applying.

Wing-Nut has unqualified listing as a pressure cable and fixture splicing connector for 474 combinations of solid and stranded copper wire. Plus all common aluminum-to-aluminum combinations. Honestly, until you try Wing-Nut, you've never made splices so good, so easily. See for yourself. SEND FOR FREE SAMPLES.

Sold through America's Leading Distributors
In Canada: Irving Smith Ltd., Montreal

IDEAL INDUSTRIES, Inc.

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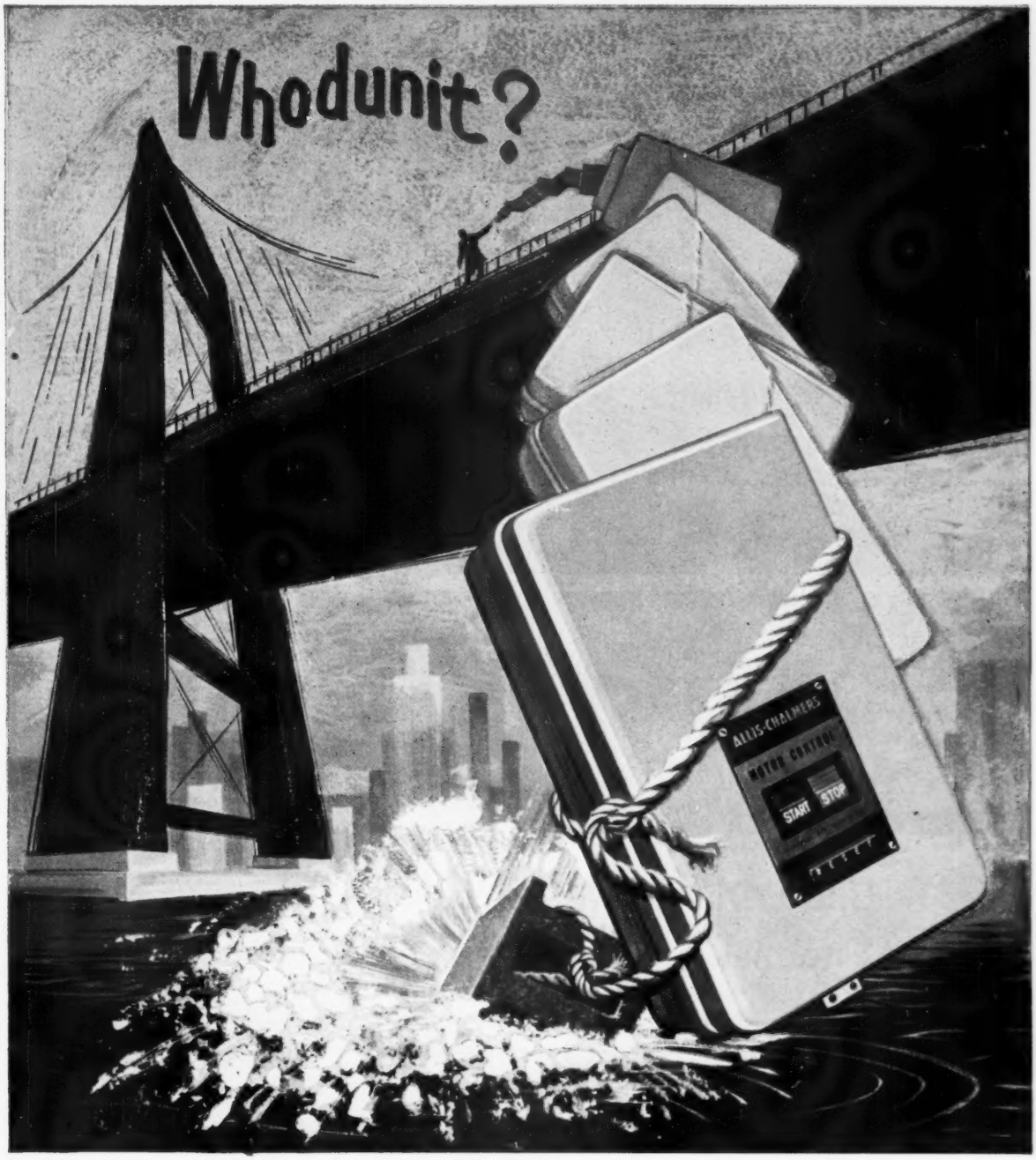


Recently our Manager of Renewal Parts Sales threatened to throw our entire line of modern, compact, easily-maintained, quickly-modified, low-voltage motor controls into the drink. Why? Because it's running him out of business! He doesn't sell a fourth of the replacement parts he used to.

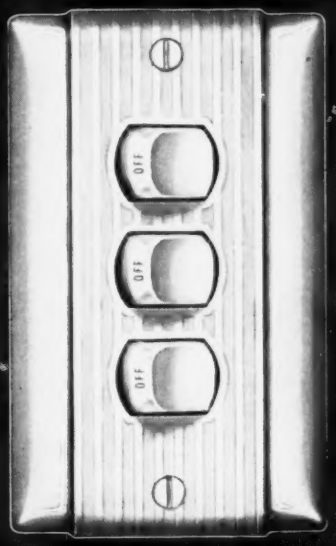
Two years ago, when our engineers designed the bulk out of the Allis-Chalmers low-voltage motor control, they built simplicity into it. And with simplicity came outstanding reliability. Our nation-wide stocks of replacement parts are gathering dust. And warranty returns are negligible.

These controls don't work under water, of course. But they do perform faithfully under practically any other conditions. And they're *still* the most advanced control design in the industry. All sizes from 00 to 9 are available from your A-C distributor. *See him for more facts or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.*

A-1485

ALLIS-CHALMERS

P&S means ROCKER-GLO and SUPER AC SWITCHES too! . . .

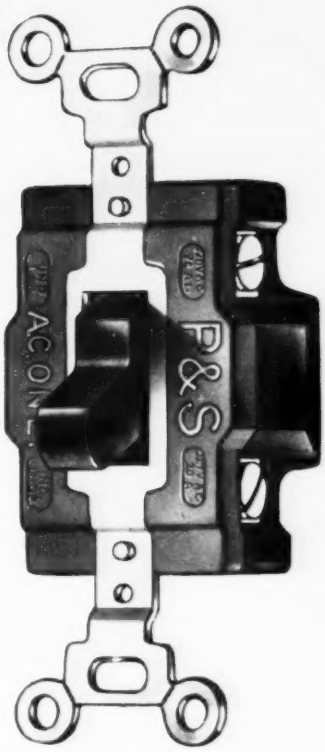


All switches are *NOT* alike. That's why it will pay you to select a switch from a manufacturer whose dependability you already know. The same engineering skill that goes into making your Rocker-Glo switches, also goes into rugged, heavy duty Super AC. For heavy duty switches or residential, you'll always do better with *Precision Switches* by P & S.

PERFORMANCE SPECIFIED

For information on Super AC switches

write Dept. ECM 861



20AC1

Now available in 30 ampere style.

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WEIGHT LOSS DUE TO ATMOSPHERIC CORROSION
after 3100 days exposure.

YOLOY

Exclusively from Youngstown—corrosion resistant steel conduit you can depend on

Hang it in the air. Bury it in the ground. Sink it in the sea. Use Youngstown rigid Yoloy steel conduit in impossible places where corrosion eats other conduit away. Use it because Yoloy lasts.

This better, tougher, bendable copper-nickel alloy steel conduit has up to 6 times the corrosion resistance of carbon steel conduit. You can cut, bend, thread, work, install and fish it with ease.

High replacement costs demand a special conduit like Yoloy. Youngstown research created it. Electrical distributors, supplied from Youngstown stocks, will deliver it in the exact quantity, size and kind you need—wherever you need it: ½" to 6" in Hot Dip Galvanized, Black Enameled or EMT.

With Yoloy, you'll get the same uniform high quality that has made Youngstown Buckeye Conduit famous in the industry. Conduit you can depend on. U.L. approved. All from modern Youngstown—largest producer of rigid steel conduit in the world.

RESISTANCE TO SOIL CORROSION
13 Soils Ranging from 2.6 pH to 9.4 pH

	CARBON STEEL		YOLOY		WROUGHT IRON	
Time (Years)	Wt. Loss*	Penetration**	Wt. Loss*	Penetration**	Wt. Loss*	Penetration**
2	6.1	52	4.3	41	4.8	48
5.4	11.1	81	7.2	52	8.8	75
7.4	12.1	89	9.5	79	10.9	89
9.3	17.4	88	10.6	79	12.2	97
14.3	19.7	107	11.8	93	16.3	98

*Wt. Loss, oz/ft² **Penetration—mils (Average Max.)

SEA WATER IMMERSION TEST

Material	Days in Test	Wt. Loss (Grams)	Corr. Rate		Pitting—Mils	
			Mdd	IPY	Max.	Avg
Mild Steel	2162	1439	36	.007	Perf.	128
Hand Puddled Wrought Iron	2384	1401	32	.006	Perf.	115
Mechanically Puddled Wrought Iron	2384	1247	28	.006	139	80
Yoloy	2420	1015	25	.005	90	62

Youngstown – growing force in steel

For information about Youngstown Yoloy Steel Conduit, write: Dept. 26B.
The Youngstown Sheet and Tube Company, Youngstown, Ohio

Niagara-Mohawk Power Corporation, Huntley Station, Buffalo, New York.

Power company selects Abolite...

Gets easy-on-the-eyes lighting, and holds the line on costs

INSTALLATION DATA

Abolite HMFAU-2400 Alzak aluminum uplight fixtures with 1000 watt color-improved mercury lamps. Ceiling height 65', mounting height 55', spacing 18' x 24'. Average maintained footcandle level: 30.

Electrical Contractor: Buffalo Electric Co.

Engineers at this power plant wanted high bay lighting that combined comfort with low installation and maintenance costs. They got it by installing Abolite fixtures equipped with 1000 watt color-improved mercury lamps.

Though these fixtures are mounted 55 feet high, they provide comfortable, glareless 30 footcandle average light throughout the building. Light directed upward through the fixtures' open tops washes out dark ceiling shadows. 35° shielding of lamp virtually eliminates glare.

Most important, this system costs less to buy and maintain than a comparable fluorescent system because fewer fixtures are needed. Maintenance costs are less, too, because air circulating through Abolite's open-top fixtures sweeps them clean of dulling dust.

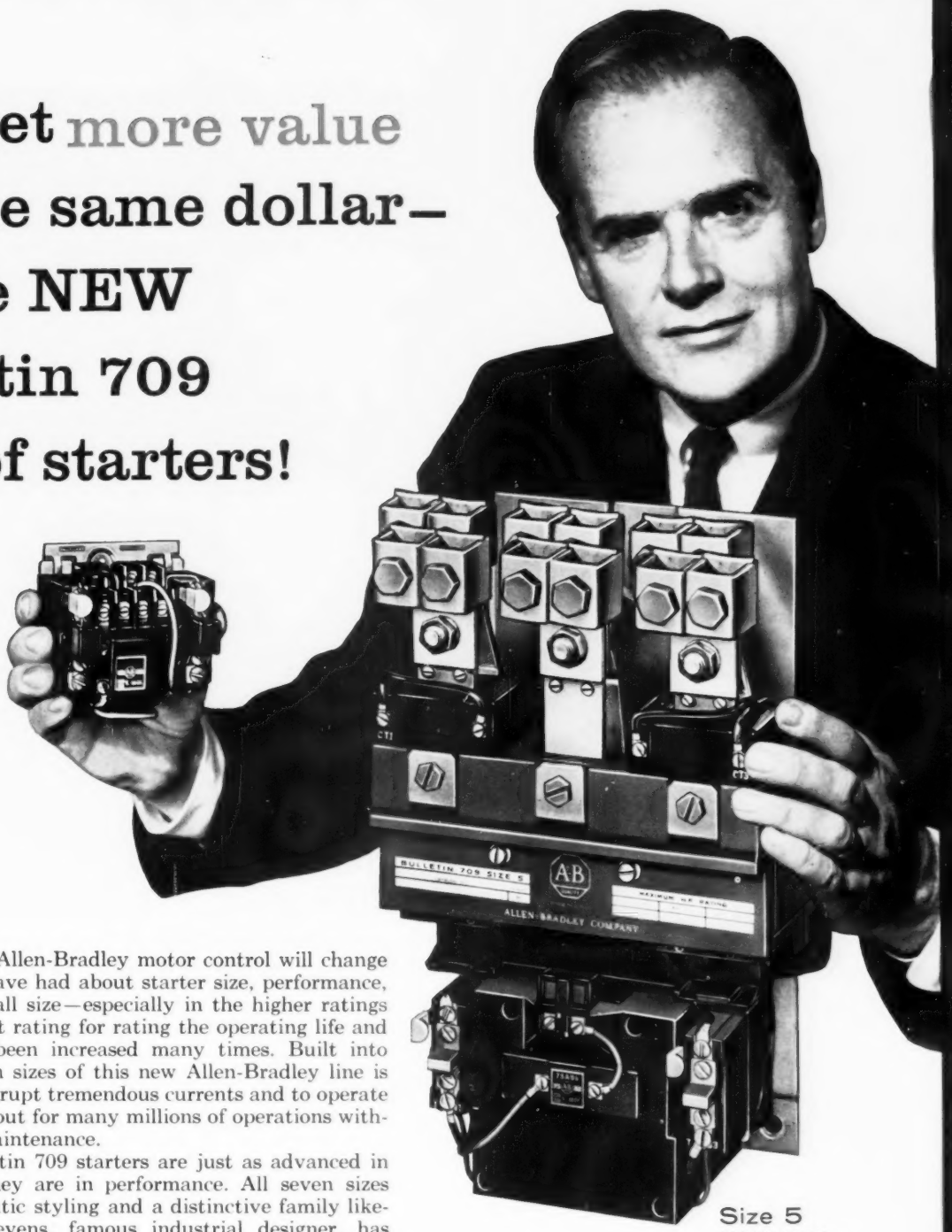
For high bay lighting that combines both comfort *and* economy, specify Abolite fixtures. The complete line includes RLM-approved Alzak aluminum and porcelain enamel fixtures for use with all kinds of mercury and incandescent lamps. Write for more information.

ABOLITE *Lighting*

THE JONES METAL PRODUCTS COMPANY

West Lafayette, Ohio

You get more value for the same dollar— in the NEW Bulletin 709 line of starters!



Size OO
1½ HP, 220 V
2 HP, 440/550 V

Size 5
100 HP, 220 V
200 HP, 440/550 V

Note the compactness of both the smallest and largest starter in the new Bulletin 709 line. Ratings up to 100 hp, 220 v; 200 hp, 440-550 v.

This new line of Allen-Bradley motor control will change every idea you have had about starter size, performance, and life. The small size—especially in the higher ratings—is startling. Yet rating for rating the operating life and reliability have been increased many times. Built into each of the seven sizes of this new Allen-Bradley line is an ability to interrupt tremendous currents and to operate year in and year out for many millions of operations without trouble or maintenance.

The new Bulletin 709 starters are just as advanced in appearance as they are in performance. All seven sizes have an aristocratic styling and a distinctive family likeness. Brooks Stevens, famous industrial designer, has given the enclosures such an attractive, modern style that these new starters will prove a distinct sales asset on any machine or installation.

Why not write today for more information on this revolutionary new line of Allen-Bradley Bulletin 709 *quality* across-the-line motor starters?

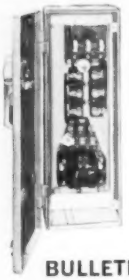
12-61-RM

ALLEN-BRADLEY

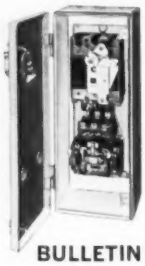
Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

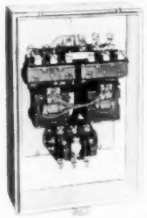
QUALITY MOTOR CONTROL



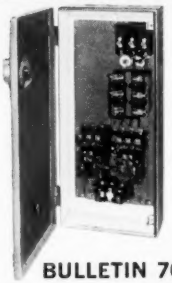
BULLETIN 712
Size 1 combination starter with fused disconnect switch



BULLETIN 713
Size 1 combination starter with circuit breaker

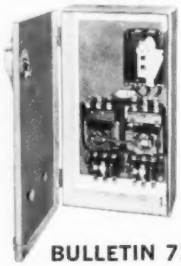


BULLETIN 705
Size 2 across-the-line reversing starter with overload relays

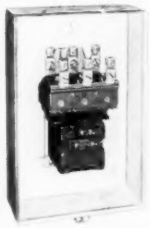


BULLETIN 706
Size 1 reversing starter with fused disconnect switch

BULLETIN 715
Size 1 across-the-line, multi-speed starter with overload relays



BULLETIN 717
Size 2 multi-speed starter with circuit breaker



BULLETIN 702
Size 3 three-pole, a-c solenoid contactor

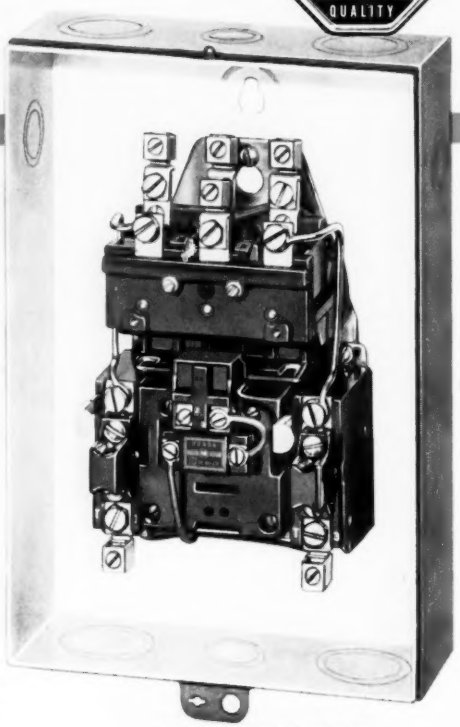
A-B QUALITY

Pygmies in Size
Giants in Performance—
the NEW Allen-Bradley Across-the-Line Starters!

This new line of across-the-line motor starters is the result of over 30 years of experience and leadership in the motor control field.

While retaining the simple solenoid principle—with only ONE moving part—these starters are completely new in every way. They are amazingly small in size—yet test after test has proved they will not only outperform but also outlast any starter now on the market. They are good for *many millions* of trouble free operations. All have scores of design refinements that make them easier to install and maintain. All are available in the smart new enclosures designed by Brooks Stevens. They make a beautiful addition to any machine or control installation.

You'll want to get the complete story about these truly revolutionary new across-the-line starters. Write for new Publication 6100.



BULLETIN 709

This popular across-the-line solenoid starter shows the new Size 2 construction. Note the white interior and generous wiring space. Bulletin 709 starters are available, in the new construction, in seven sizes—Sizes 00 to 5, with a maximum rating of 100 hp, 220 v; 200 hp, 440-550 v.

12 61-RM

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

QUALITY MOTOR CONTROL

Anthony Chronis, (left) President, Lisle Electric, Inc., Lisle, Ill. talking to Al Jones, his Dodge Representative on a job site.

"Dodge Reports saved our business in its early days ...today, they give us 1/3 of our volume"

"Shortly after I took over this business, we lost an account that represented 50% of our volume," says Mr. Chronis. "We had to round up a corresponding amount in a very short time in order to remain in business at all. We did it through Dodge Reports which we had never used before."

"For the first three months of our subscription," Mr. Chronis explains, "we conducted an intensive promotional campaign based on Dodge leads. It was so successful that after those first three months we had all the business we could handle."

Mr. Chronis began with three men and three trucks, and restricted his contracts to residential construction. "Today," he says, "we have 10 men, five trucks and a trailer. We handle stores, houses and apartment buildings and are beginning to establish our reputation in electrical heating work, engineering and quality custom installations. Last year we completed more than $160,000 worth of contracts, $50,000 of which we picked up solely through Dodge information."

Mr. Chronis goes through each day's Dodge Reports himself, and carries the ones he wants to bid on in his car. When he passes a prospect's site, he says, "I stop the car, walk through the mud and see the contractor on the spot. That's where I can sell our services, because Dodge Reports have told me all I need to know about the job. And, whenever our name appears in Dodge Reports to show that we've been awarded a contract, we feel that it's the best advertising our company can get anywhere."

Dodge Reports can help you get the new business you want, too—for only a fraction of the profits they'll help you earn. Send the coupon for further details. Or, consult your telephone directory for the Dodge office (in over 80 principal cities) nearest you.

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I'd like to receive your free booklet, "How to Get More Business in the New Construction Field" and details on how Dodge Reports can help me increase volume and profits.

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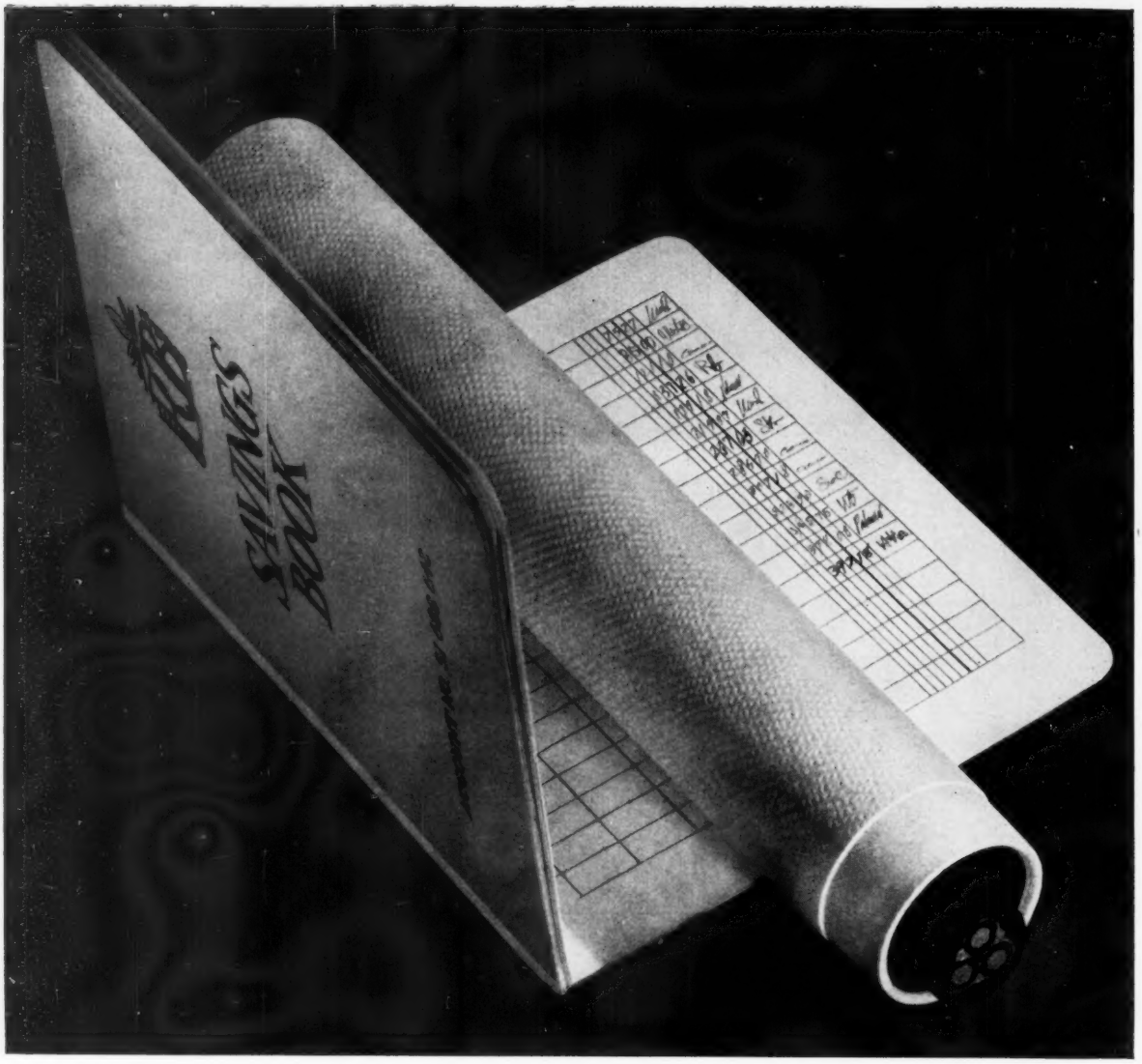


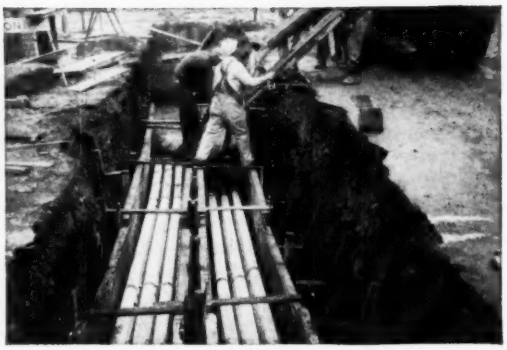
Save on installed costs with Transite Electrical Ducts

To meet today's strict conduit specifications and, at the same time, keep installed costs down, more and more contractors are turning to Transite® Ducts.

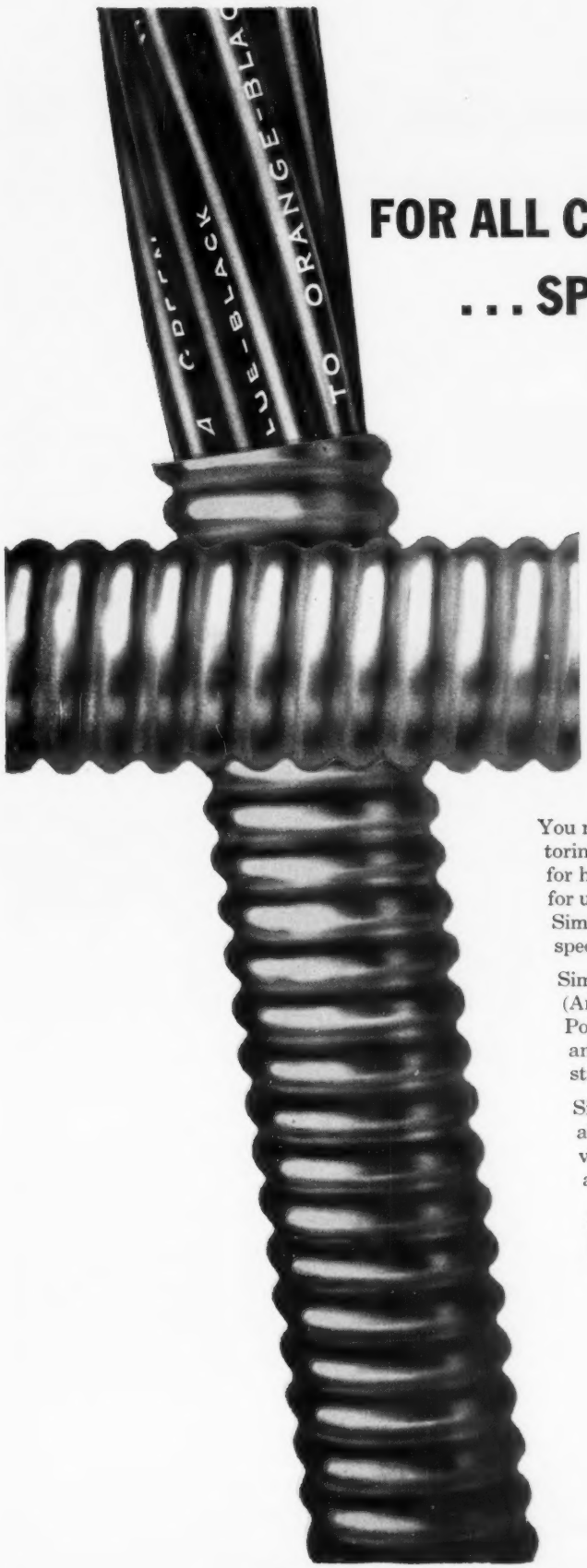
Transite's long lengths and light weight reduce handling and laying costs. This, combined with a quick coupling method, permits rapid assembly. A small but complete line of fittings simplifies the assembly of duct-bank configurations even with complex constructions. Finally, the smooth inner walls of Transite make cable pulling easier—reduce strain on both the cable and pulling equipment as well as the duct. Result? Fast installation and a saving on every foot of duct you lay!

Non-combustible, non-sparking Transite resists corrosive soils, electrolytic action and stress of normal soil movement. Its tight joints are flexible yet permanent. They lock out water-borne silt, roots and other system disrupters.

For full details, write Johns-Manville, Box 14, ECM-8, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.



JOHNS-MANVILLE JM PRODUCTS



FOR ALL CONTROL CABLE NEEDS ... SPECIFY SIMPLEX CABLE

RUBBER, PVC, SILICONE, POLYETHYLENE-NYLON, POLYETHYLENE-PVC, POLYETHYLENE, TEFLON

You name the requirement: supervisory cable for monitoring and/or recording; cable for protective devices, for heavy magnetic trip or break devices; control cable for use in conjunction with high voltage power circuits. Simplex will supply it . . . engineered precisely to specifications.

Simplex control cable insulations include rubber (Anhydrex, Anhydrex XX), PVC, Polyethylene, Polyethylene-Nylon, Polyethylene-PVC, Silicone and Teflon. And they meet all IPCEA-NEMA standards.

Simplex cables are available with copper, bronze, aluminum and steel C- L- X sheaths or with a variety of other jacketing materials. Also available are packaged combinations for power and control.

Simplex welcomes the opportunity of discussing individual control and power cable problems. Write today, giving details.

Simplex
WIRE & CABLE CO.
Cambridge, Mass. • Portsmouth, N. H.

Three new electrical applications use HYPALON® for color coding, resistance to weather, ozone, corona

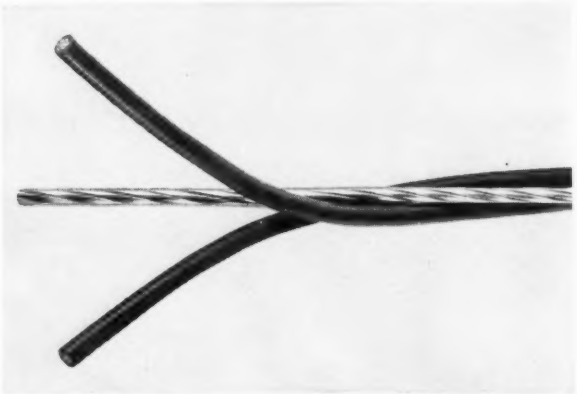
High-Performance Du Pont Synthetic Rubber Proves Its Versatility as Jacketing and Insulation for Wire and Cable.

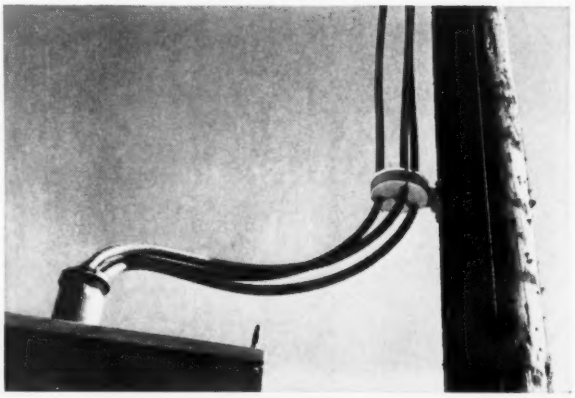
Color-coded triplex with HYPALON jacket *and* insulation permits accurate phase identification. HYPALON jacket will not discolor . . . resists flame, weathering, abrasion, hot and cold flow.

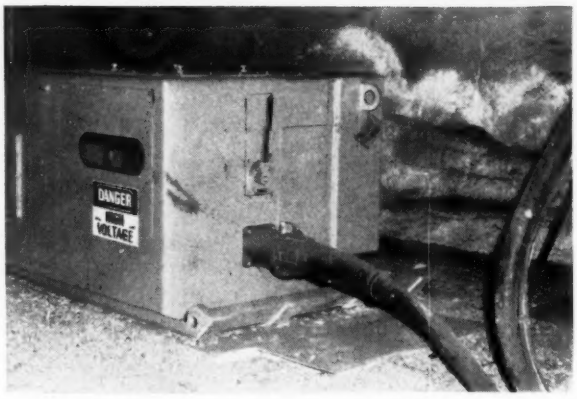
Aerial cable for industrial locations is covered with HYPALON for resistance to corrosive fumes, air-borne chemicals, ozone and corona discharge. HYPALON jacketing is *practically immune* to ozone, will not support combustion, resists exposure to oil and grease.

Corona-resistant connectors molded of HYPALON are rated at 7500 volts . . . permit the use of higher voltage portable machinery in plants and mines. HYPALON is virtually corona-*proof* compared to other elastomers . . . offers good resistance to abrasion, oxidizing chemicals.

These latest electrical applications for HYPALON synthetic rubber illustrate the versatility obtainable with this new wire and cable covering material. HYPALON's outstanding resistance to weather, aging, ozone, corona, flame, abrasion, oil and chemicals (proven in 10 years of wide industrial use) means long life and economical performance to meet the most demanding service needs. That's why HYPALON is specified for high-performance automotive ignition wire . . . mine trailing cable . . . tree wire . . . service drop wire . . . submarine cable . . . building wire . . . to list just a few of its current applications. Learn more about Du Pont HYPALON and how it can improve performance of the cable and electrical accessories *you* use. For information, write E. I. du Pont de Nemours & Company (Inc.), Elastomer Chemicals Dept. ECM-8, Wilmington 98, Del.







DU PONT
REG. U. S. PAT. OFF.

HYPALON
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

Bring out the best in Electric Heating with Honeywell quality controls

The new Honeywell T462 Line Voltage Thermostat offers the very finest for your economy-minded customers. A beauty in any room, this compact new thermostat gives dependable, worry-free performance—high load capacity plus accuracy and responsiveness. The new T462 was especially developed for electric heating, with a control range from 40°-85° with less than one-half degree differential. The T462 offers everything you could ask for in a quality-built line voltage thermostat.

Honeywell

First in Control

SINCE 1885

T462A—SPST Switching With Manual Single-Line Break in "No-Heat" Position.
T462B—SPST Switching With Manual Double-Line Break in "Off" Position.
For complete data on these and the complete line of low voltage controls, write Honeywell, Department EC-8-13, Minneapolis 8, Minnesota.

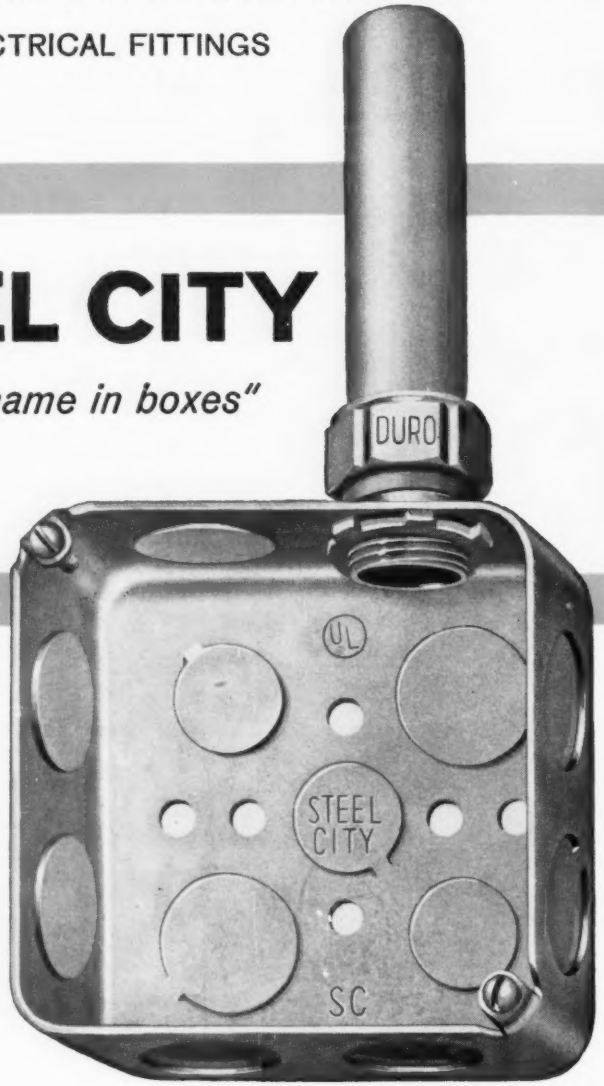
CONNECTING TWO GREAT LINES

TO BRING YOU BETTER VALUES IN

ELECTRICAL FITTINGS

STEEL CITY

"Biggest name in boxes"



NOW

most complete line of fittings

COMPRESSION

SET-SCREW

INDENTOR

TWO-PIECE

Steel City meets your every need with a complete line of EMT fittings: Complete range of sizes ■ Full range of off-set fittings ■ All fittings accurately sized and fully threaded ■ Heavy gauge steel lock nuts ■

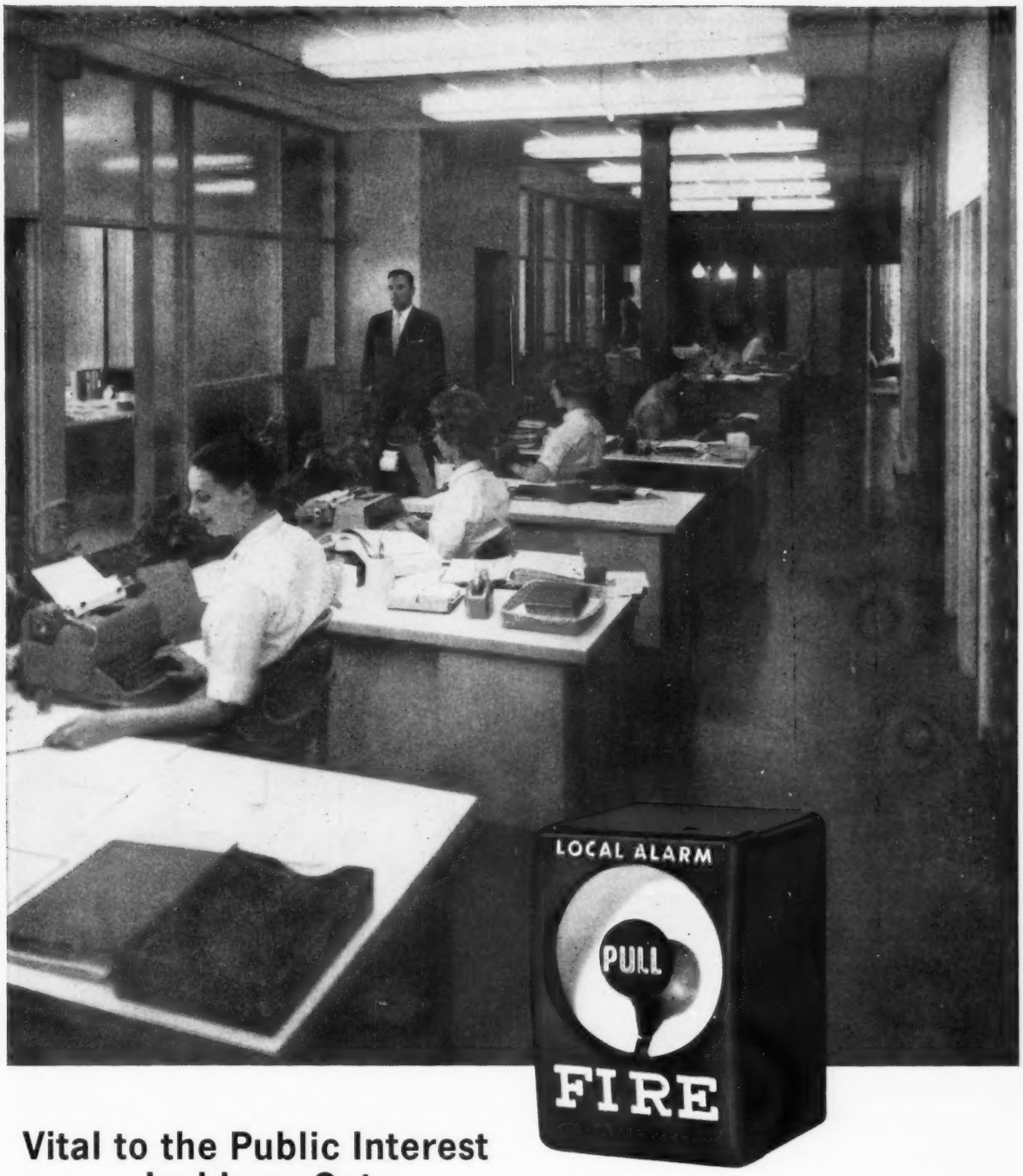
STEEL • PRESSURE CAST • COMBINATION PRESSURE CAST & STEEL

FIRST in boxes . . . now FIRST in fittings . . . and ALWAYS FIRST IN QUALITY

STEEL CITY ELECTRIC COMPANY

Subsidiary of American-Marietta Company

PITTSBURGH 33, PA.



Vital to the Public Interest Inside or Out

For over 100 years, Gamewell street fire alarm boxes have been a familiar part of the American scene. Triggering alarm systems in thousands of American communities, they have saved countless lives, many millions of dollars worth of property. And Gamewell alarm systems have always responded with unerring reliability!

Gamewell FLEXALARM *interior* fire alarm signal systems offer the same high standards of reliability. They can be planned as part of complete fire protection for *any* building: institutional, commercial or industrial — public or private.

Gamewell will be happy to show you how you can plan maximum protection at minimum cost — for new construction, expansion or modernization. Safety is everybody's business . . . our profession.

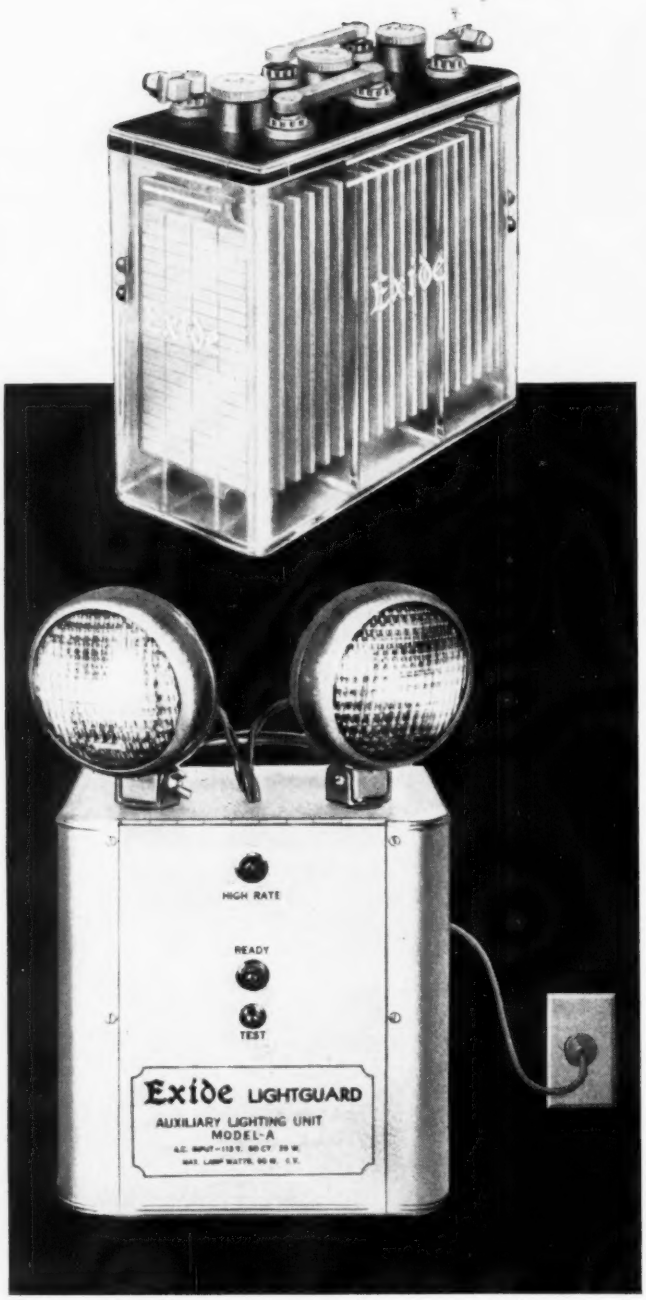
Contact your Gamewell engineer or write THE GAMEWELL COMPANY, 1320 Chestnut Street, Newton Upper Falls 64, Mass. A Subsidiary of E. W. Bliss Company.

BLISS Gamewell®

FIRST... WHEN SECONDS COUNT

YOU NEED A GOOD BATTERY FOR GOOD LIGHT

Only Exide Lightguard® emergency lighting units have genuine Exide storage batteries. Extra capacity and extra life are built in. When your regular power fails and Exide Lightguard goes on, you're assured of extra hours of strong light. And you can go for a good many years without battery replacement expense. Exide Lightguard is completely automatic. Goes on when lights go out. Built-in charger automatically brings battery back to capacity after each time used and keeps it there. Easy to install. Just plug into regular a-c outlet. Ask about it at your nearby electrical distributor's. Or write for literature. Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.



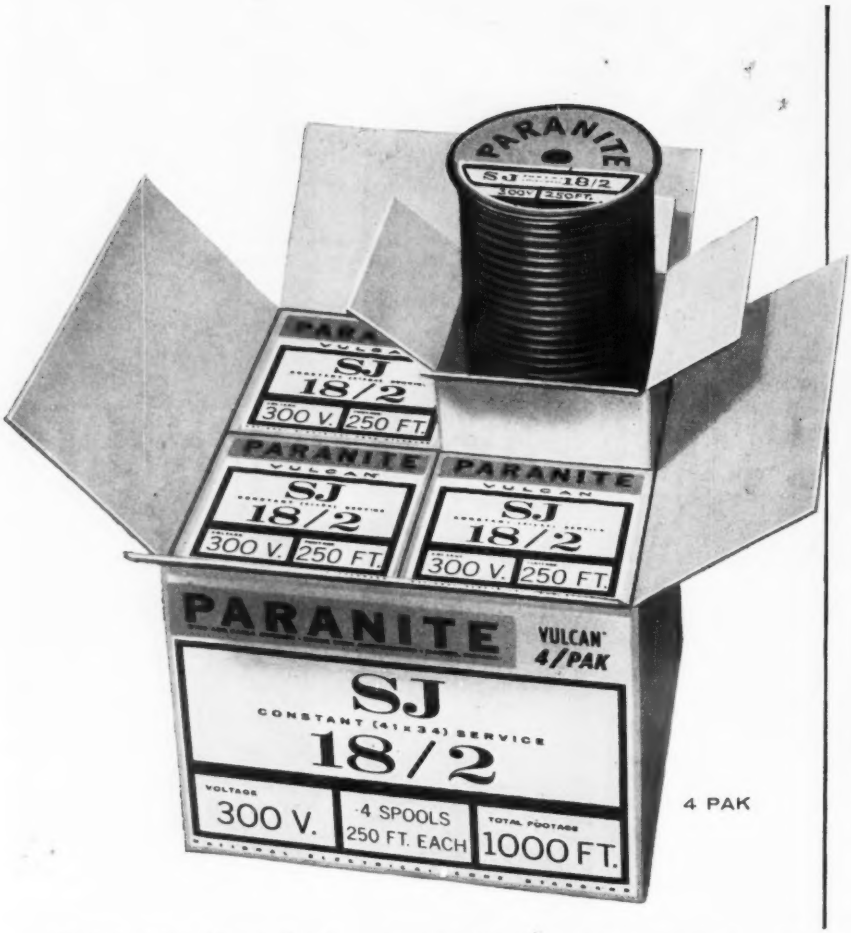
When regular lights go out, Lightguard goes on . . . instantly and automatically. This is Model A, the most popular model. Available for one, two or three lamps.

Exide®

INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company ESB

◄ **Dry cell model**
Most economical to buy. Same lamp brilliance as storage battery model. Uses standard dry cells.

To cover large areas ►
New Model E. Three times the battery capacity. Can handle up to five lamps.



4 PAK

2 PAK

COILS IN CARTONS

NON-RETURNABLE
WOOD REELS

Quick identity labels... easy ship 'n store cartons... always clean cords with

SERVA-PAC PACKAGED PARANITE PORTABLE CORDS

Spot the Paranite portable cord you want . . . and spot it in a flash. Every reel, carton and pak now has Serva-Pac labels that give you size, type, voltage and quantity at a glance. It means positive savings to you in inventory control, error-free assembly of orders and accurate identification on the job. And there is a broad line of Paranite portable cords in these new easy handling cartons that keep the cords clean during storage . . . Vulcaprene® neoprene sheathed cords, Vulcan rubber sheathed cords, and Dreadnaught heavy duty cords . . . all UL labeled and all to premium quality standards.

Type ▶	S	SO	SJ	SJO
Two 250′ 2 Paks per master carton	18/2-3 16/2	18/2-3 16/2	18/4 16/3-4 14/3-2	18/4 16/3-4 14/2
Four 250′ 4 Paks per master carton			18/2-3 16/2	18/2-3 16/2
250′ Coils in cartons	18/4, 16/3-4 14/2-3-4 12/2-3-4 10/2-3-4	18/4, 16/3-4 14/2-3-4 12/2-3-4 10/2-3-4		
250′ Non-Returnable wood reels	8/2-3-4 6/2-3-4	8/2-3-4 6/2-3-4		

Since 1890

PARANITE WIRE & CABLE DIVISION

ESSEX WIRE CORPORATION, Marion, Indiana

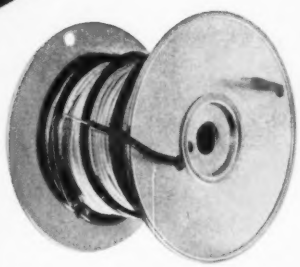
MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Anaheim, Calif.

Sales Offices and Redistribution Warehouses in all Principal Cities

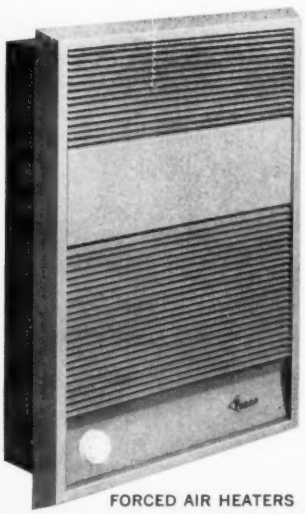
Before you buy . . . check

FASCO
ELECTRIC HEAT

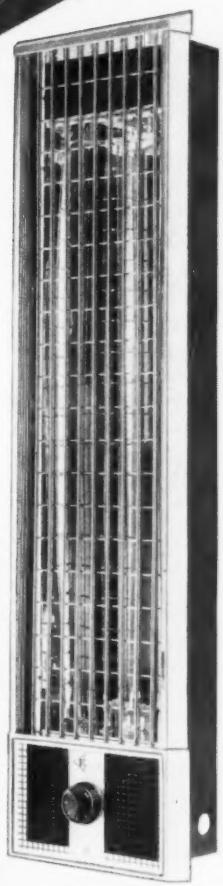
IN ANY ROOM... IN ANY HOUSE... FASCO ELECTRIC HEAT OFFERS "EASILY INSTALLED" QUIET COMFORT



CEILING OR FLOOR CABLE HEAT



FORCED AIR HEATERS

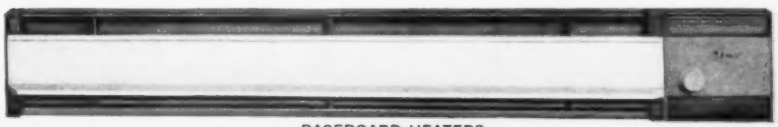


RADIANT WALL HEATERS

Whether installing one unit for supplementary heat or utilizing the full Fasco heat line for a new home, you get economical, simple installation together with room-by-room comfort control and quiet performance. Facso baseboard, radiant wall, and forced air heaters have slim, neat styling, scientifically directed air flow, rugged dependability that eliminates call backs. High-efficiency heating elements give clean, uniform, draft-free heat quickly and quietly.

Taken together, these are the extra values that make Fasco electric heat a standout. Check for yourself to see how Fasco electric heat "fits the bill" for installer *and* user. Use it in the ceiling, floor, wall—upstairs and downstairs—in any size home, in any size room.

Write Fasco Industries, P. O. Box 509, Rochester 2, New York, for complete full-line catalog and any heat installation information required.

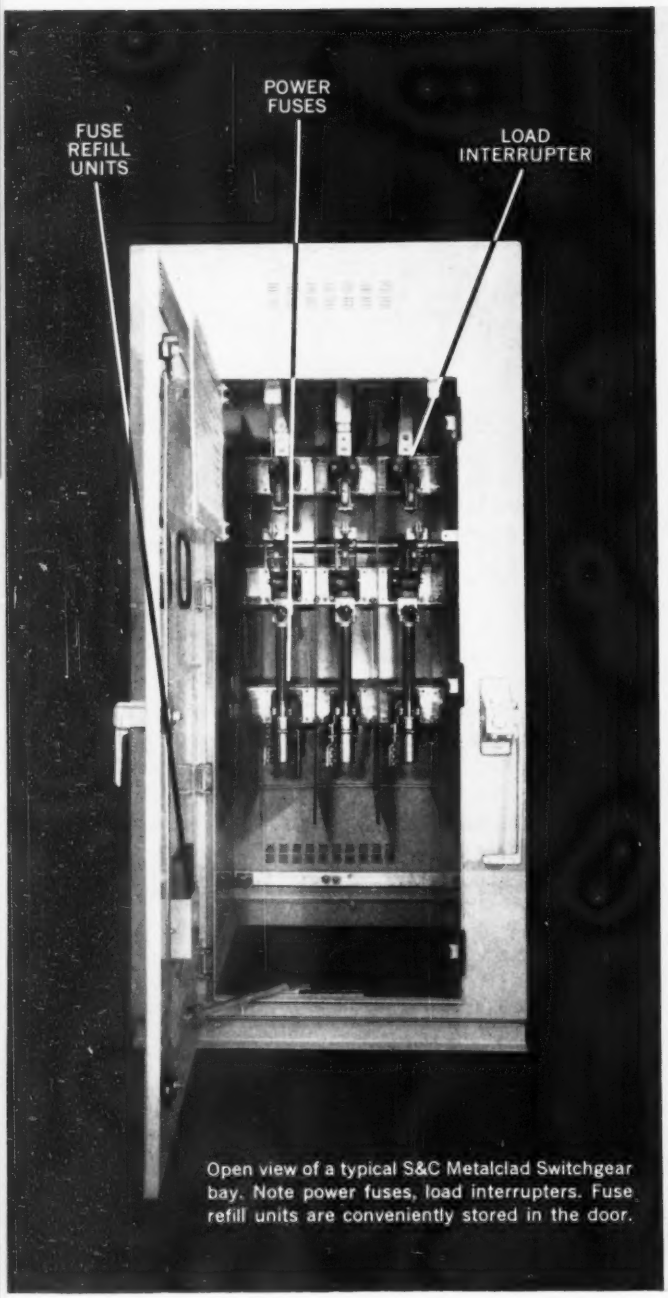


BASEBOARD HEATERS

Styled to please...Designed to perform

FASCO INDUSTRIES, INC., ROCHESTER 2, N.Y.

Leave it to the girls



Open view of a typical S&C Metalclad Switchgear bay. Note power fuses, load interrupters. Fuse refill units are conveniently stored in the door.

They can handle all the maintenance your 2.4 thru 14.4-kv switchgear ever needs . . .

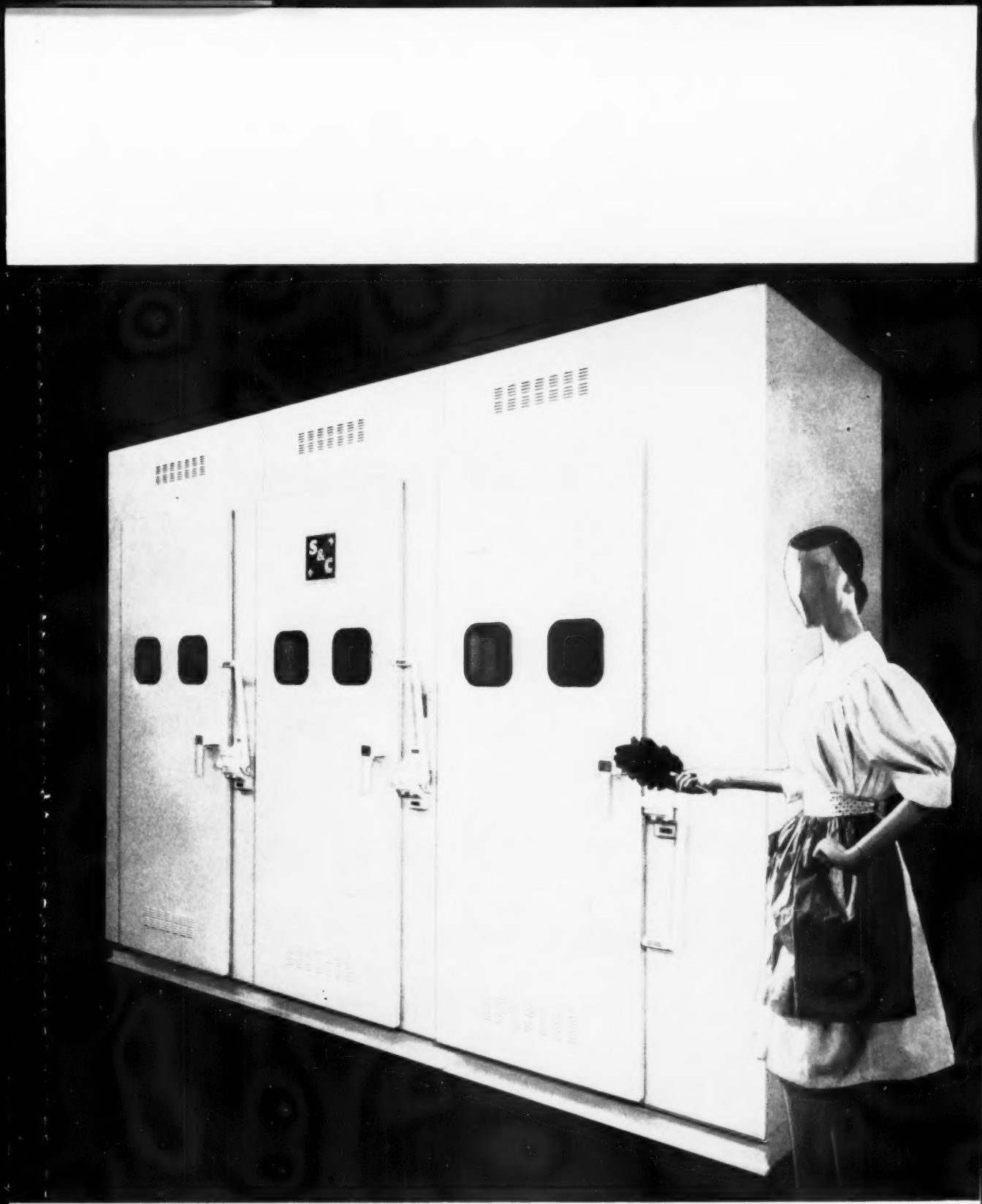
. . . if it's S&C Metalclad Switchgear, that is. For S&C Metalclad Switchgear contains maintenance-free fused load interrupters. (Load interrupters handle all load switching; power fuses handle fault protection.) Fused load interrupters will always work—never need adjusting, setting, inspection, dielectric testing, or periodic exercising and lubrication. Compared to the suggested maintenance schedules for circuit breaker type switchgear, there's virtually no maintenance required.

Equally important, unqualified maintenance personnel can't tamper with planned fault protection—since power fuses employ no relays. What's more, the operating characteristics of S&C power fuses do not change with age or current surges. Current-carrying ability and time-current characteristics of these fuses are permanent.

Remember, too, that this switchgear will cost about half as much as the circuit breakers you might be used to. And it offers full-load switching up to 1200 amperes plus fault interrupting up to 500,000 kva in voltages from 2.4 thru 14.4 kv. It meets all NEC requirements for fault-closing and short-circuit interruption . . . and its performance is proved by high-power tests at KEMA laboratories.

Next time you are thinking about high-voltage switchgear for service entrances, switching centers, substation primaries or substation secondaries . . . leave it to the girls as far as maintenance is concerned. As far as application help is concerned, leave it to your S&C sales engineer. Look for him in the Yellow Pages (Electrical Equipment) in all principal cities. Or write to:

S&C ELECTRIC COMPANY
4433 Ravenswood Avenue • Chicago 40, Illinois
Specialists in High Voltage Circuit Interruption since 1911

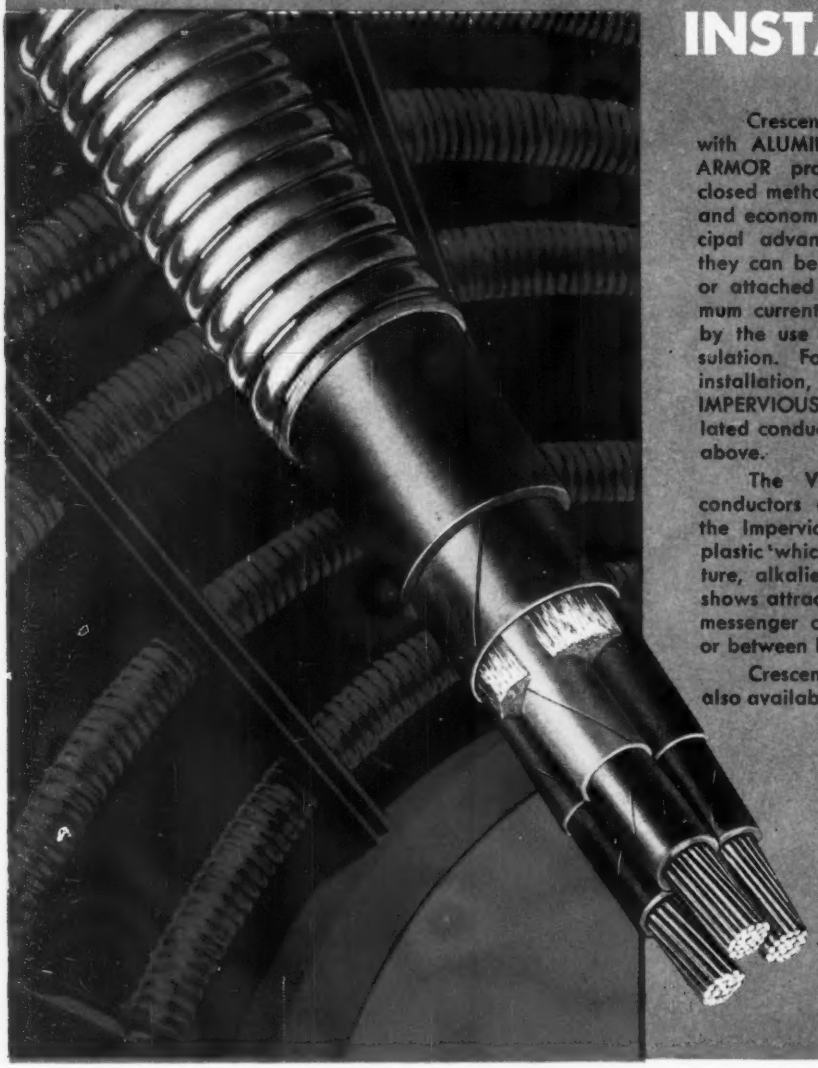


Equipment shown is an S&C Metalclad Switchgear Assembly (13.8 kv) used as a switching center. (Dusting is optional!)

CRESCENT

INTERLOCKED ARMOR POWER CABLE

GIVES YOU *SPEED* and *ECONOMY* OF INSTALLATION



Crescent Interlocked Armor Cable with ALUMINUM or GALVANIZED STEEL ARMOR provides a flexible metal-enclosed method of wiring for power. Speed and economy of installation are the principal advantages of these cables since they can be placed on easily hung racks or attached to building surfaces. Maximum current carrying capacity is secured by the use of the varnished cambric insulation. For outdoor or damp location installation, it is furnished with SYNTHOL IMPERVIOUS SHEATH between the insulated conductors and armor, as illustrated above.

The Varnished Cambric insulated conductors are thoroughly protected by the Impervious Sheath of tough thermoplastic which is highly resistant to moisture, alkalies, acids and oils. This cable shows attractive savings when strung from messenger cables or in troughs outdoors or between buildings.

Crescent Interlocked Armor Cable also available with butyl rubber insulation.

CRESCENT INSULATED WIRE & CABLE CO., INC.

TRENTON, NEW JERSEY

ADVAN guard®

AUTOMATIC RE-SETTING THERMOSTAT

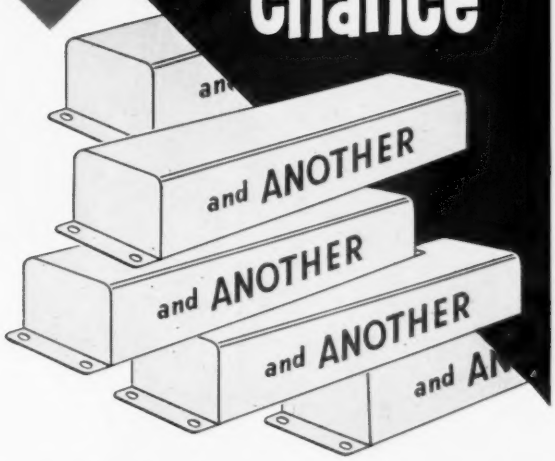
gives fluorescent lamp ballasts..... a 2nd chance

prevents

PREMATURE DESTRUCTION

from:

- **Abnormal Operating Temperatures**
- **Incorrect Voltage Supply**
- **Excessive Current**
- **Internal Short Circuiting**
- **Inadequate Lamp Maintenance**
- **Lamp Rectification**
- **Improper Fixture Application**



Protects against end-of-life hazards . . . eliminates the need for individual fusing.

Only ADVAN-guard®, a thermally actuated protective thermostat sealed in the ballast housing, gives fluorescent lamp ballasts a "Second Chance." It automatically "trips-out" whenever the ballast operates at abnormal temperatures from any internal or external cause. Unlike other protective devices which permit premature ballast destruction by cutting the ballast out of the line only after it has been destroyed, ADVAN-guard® cuts out before heat can cause premature destruction, resets automatically when the trouble has been corrected and permits the ballast to resume normal operation. Insist on ADVAN-guard® equipped fluorescent lamp ballasts for safety and longer life.

"The Heart of the Lighting Industry"

Mfg. in Canada by: Advance Transformer Co., Ltd. 5780 Pare St., Montreal, Quebec

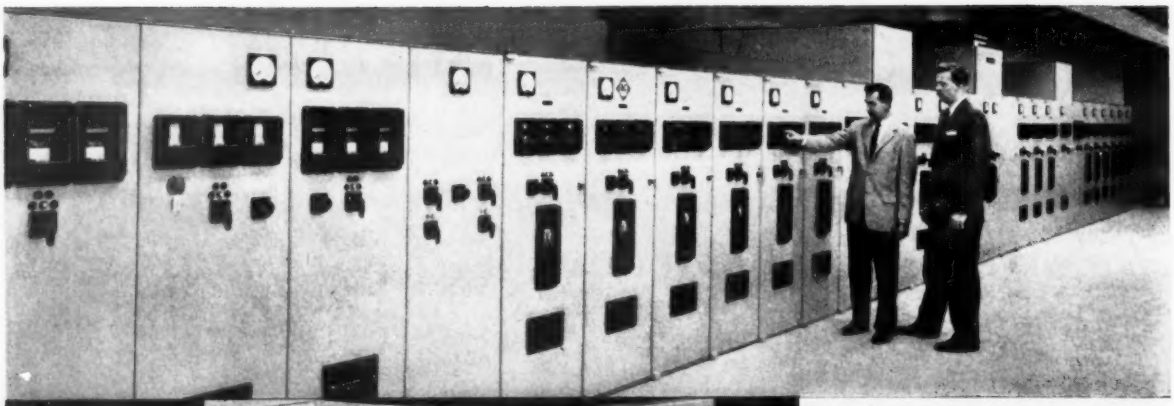
ADVANCE®

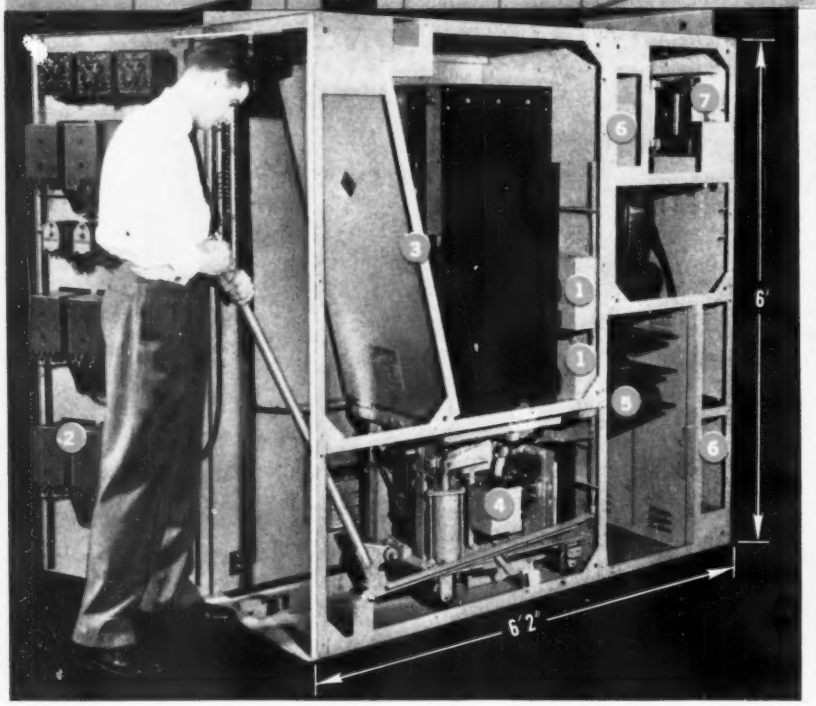
WORLD'S LARGEST EXCLUSIVE MANUFACTURER OF FLUORESCENT LAMP BALLASTS

TRANSFORMER CO.

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

ALLIS-CHALMERS





▲ 4.16 kv metal-clad equipment serving a west coast city.

1. Separate compartments for current transformers.
2. Full panel metering and relaying.
3. Double-lock panel for operator safety.
4. Easy service accessibility without dismantling.
5. Glass polyester insulation throughout.
6. Separate up-feed and down-feed cable compartments.
7. Fully cast, trunnion-mounted potential transformers.

Lowest height, easiest access

the only switchgear with fully isolated current transformers

The front-accessible current transformers can be inspected, maintained or replaced without exposure to any high voltage compartment. A-C metal-clad units are just 72 inches high — means eye-level instrumentation . . . shoulder-height accessibility of component parts. And the entire panel can be used for meters and relays. Maximum compartmentation and dead-front construction offer greater safety. Buswork and components arranged for easy addition of future units.

You get rapid, one-stroke insertion of the circuit breaker. The breaker has glass polyester insulation for highest impulse strength . . . the only self-locking protective barrier . . . four-bar linkage is mechanically, electrically trip-free. Primary disconnect fingers eliminate use of garter springs, and are on the circuit breaker for easy inspection. Both stored energy and solenoid operators are available. *For more switchgear information contact your nearby* **Allis-Chalmers** *office.* A-1457

WIREMOLD® ELECTRIC IDEAS

PREPARED EACH MONTH FOR ELECTRICAL CONSTRUCTION AND MAINTENANCE TO BRING IDEAS, NEWS AND HELPFUL INFORMATION TO ELECTRICAL MEN

62nd YEAR

AUGUST 1961

Surface Systems Simplify Power And 'Phone Wiring

Tele-Power system puts high and low potential wiring in separate compartments for safe, easy-to-reach installation

Recognition of the importance of having communications wiring easily accessible for maintenance and expansion has led to the growth of a new approach in wiring offices and institutions.

The new method, called Tele-Power, uses surface systems for power and communications wiring, yet *keeps each type of wiring within its own raceway.*

Thus, at one time, the user is given the benefits of a low potential system that meets the recommendations of the telephone companies as well as the convenience of a multi-outlet system for power and lighting.

continued on third page

PARALLEL RUNS of raceway house power and light wiring in upper run, telephone wires in lower. With each type in its own compartment, there is no chance of wires being exposed to each other. Inset shows type 30 terminal block inside 3000 raceway.

Code Comments

Conductor Size Limit

Q. *What is the largest size conductor that may be installed in surface metal raceways?*

A. Section 352-3, Article 352 of the code specifically limits the conductor size to a maximum of No. 6.

Low Voltage Conductors

Q. *When using 3000 and 2100 in communication work, such as with nurses' call systems, fire alarms, etc., are there any Code restrictions as to the number of low voltage wires or multi-conductor cables that can be put in a single raceway?*

A. The above in general are classified as Class 2 circuits and fall in the category of low-energy power circuits. The number of conductors for this type of circuitry which may be installed in either 3000 or 2100 is covered in Section 725-15, along with Table 3 of the Code.

Extending Through Walls and Floors

Q. *May surface metal raceways be extended through walls and floors?*

A. According to Section 352-5, Article 352, "Except in multi-outlet assemblies, raceways may be extended through dry walls, dry partitions and dry floors, if unbroken in lengths passing through." Multi-outlet assemblies are covered in Section 353-3, Article 353 which permits extending through (not run within) " . . . dry partitions, providing arrangements are made for removing the cap or cover on all exposed portions and no outlet falls within the partitions."

WIREMOLD®

Editorial

Two way street

"The Wiremold Systems are as good as they are because — since the founding of our company in 1900 — Wiremen, Electrical Contractors, Electrical Inspectors and Engineers have given us an opportunity to help them in the solution of their wiring problems. . . . Without their cooperation, we could accomplish little; with it, the toughest of wiring problems are readily solved."

This is the thought with which each issue of the Wiring Guide is introduced.

To carry this idea further into practice, with this issue we begin a new department — "Ground to Ground" — in which we ask a question we hope you will take the time to answer. More about this below.

Product of the Month

Tool simplifies cover removal from Pancake® 1500 and 2600

Designed to simplify and speed up the removal of the cover from Pancake 1500 and 2600 overfloor systems, the 656 Cover Removal tool is easy to use and small enough to fit in any tool case.

Each end of the tool is made to fit one of the two raceways and is stamped with the series number for easy identification. Use of the tool eliminates any danger of twisting or kinking the cover section.

To use the 656 tool, start at one end of the cover, or where cover joins fitting, and progress toward opposite end. Firm and steady pressure should be applied, but care should be taken not to force cover.

After removal, cover may be installed by the normal method. Hook one side of the cover under the bead of the base and apply pressure by stepping on cover with a glancing blow until it snaps in place.

Quiz Corner

Q. *In wiring 2127G receptacles, should the wire be wrapped completely around the terminal screw?*

A. No. The wire should only be looped around the screw.

Q. *What Wiremold fixture boxes can be used with narrow laminated arch construction in current use in churches and schools?*

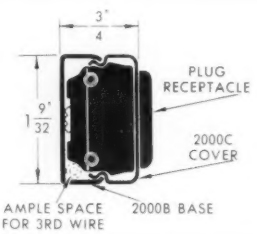
A. 5737 and 5738 which have smaller diameter (4¾") than the 5737A and 5738A.

Q. *How do I feed 2600 Pancake from ¾" pipe down a column?*

A. Connect pipe to 2182A Entrance End Fitting, then use a short length of 2100 Wiremold which will permit connecting to the 2600 through a 2186 Adjustable Offset Connector.

Q. *Is there room in 2000 Plugmold for an additional No. 12 Type TW wire?*

A. Yes. The receptacle is designed to permit a conductor to pass by.



Ground to Ground

With this issue, we begin a new department. We hope you will take the time to dash off a frank answer to the questions asked. Your cooperation will help to improve our products and services to you. Answers will not be published, but will be acknowledged. Please address reply to:

Ground to Ground
The Wiremold Company
Hartford 10, Conn.

Is our method of supplying your distributor adequate for your needs? That is, are we furnishing a sufficient selection of all the Wiremold series, fittings and devices? If not, which is the item(s) you have the most difficulty obtaining?

WIREMOLD®

WIREMOLD ■ HARTFORD 10, CONN.
Gentlemen: Please send me checked items

NAME _____

COMPANY _____

ADDRESS _____

- ☐ Tele-Power Data Sheet (A-14)
- ☐ Branch Circuits in College Building (A-15)
- ☐ Electric Ideas, July 1961
- ☐ Electric Ideas, June 1961
- ☐ Wiring Guide (Catalog 22)

E1-8

Power and 'Phone Wiring continued from first page

GROUNDING TYPE duplex outlets were used in power run of this Tele-Power set-up. The upper run houses telephone wires.

TWIN RACEWAYS of 2100 series permit modern power and phone wiring in this executive office.

POWER WIRING is complete; phone installer has own section for low potential wiring within separate raceway.

Basically, a Tele-Power system consists of a pair of parallel runs of Wiremold raceways — one for telephone, signal and interoffice wiring; the other for power and light wiring. The system is practical for both new and old buildings.

For both the installer and the user, Tele-Power systems provide many advantages in terms of service, convenience, economy, and flexibility.

Because each raceway has its own cover, the electrical contractor or telephone installer needs only install, or remove the cover for, the wiring that concerns him. Thus, the high and low potential wiring are not exposed to each other. When assembling, or reassembling, there is no chance of a fault developing in the wiring outside the installer's jurisdiction.

Because Tele-Power systems are part of the basic product line, the complete array of fittings can be used, saving the cost of expensive special fittings. Also, no new installation techniques are needed; anyone who has installed surface raceways can install a Tele-Power system.

The usual advantages of surface systems, of course, go with the Tele-Power system: covers are easily snapped into the base without fittings or screw holes; receptacles can be located anywhere along the power run; and, by specifying raceways with extra capacity, additional wiring can be installed whenever needed without disturbing the rest of the system.

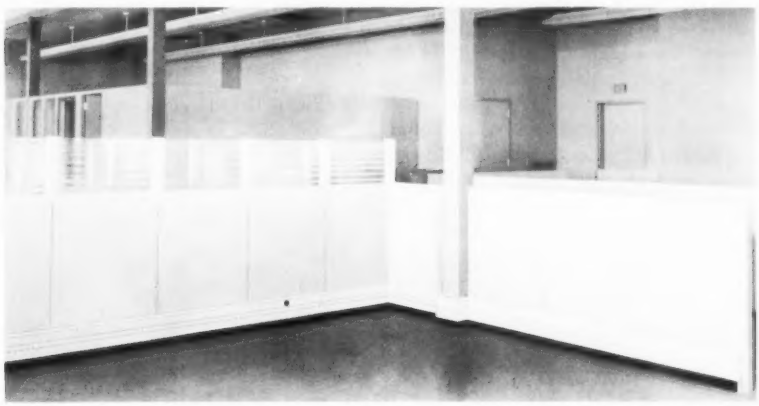
The completed installation is neat and virtually unnoticeable. The two raceways fit closely together with no gap between them.

Most commonly used raceways are the 3000 series and the 2100 series. In addition to capacity, the 3000 series also is designed to accept type 30 multi-terminal blocks for telephones directly in the raceway. This avoids mounting the blocks on the wall, and still leaves ample space in the raceway for additional cabling.

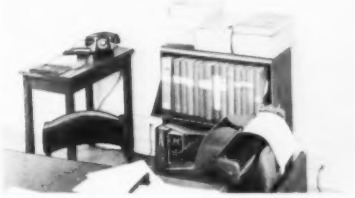
Of course, Wiremold 2000 and 2200 also are used. Either series has the additional feature of being designed for use with Snapicoil®, 50-ft. lengths of pre-wired receptacles which eliminate multiple splices between short lengths.

Tele-Power systems may be installed using the same raceway series for both runs, or using different series for power and communications.

Tele-Power systems offer the maximum in modern wiring — to the specifier, installer and user.



THREE RUN Tele-Power system uses center strip of Plugmold 2000 with outlets 30-in. on center, while two runs of 2200 raceway house phone wiring and a PAX system.



CONVENIENCE of multi-outlet system for operating business machines is combined in this Tele-Power installation with latest in communication wiring techniques.

WIREMOLD®

Advertisement

Engineered Specials

Press-mounted Plugmold® is power source for mold areas

PROBLEM:

To provide convenient power source for upper and lower mold areas on vertical transfer molding machine.

SOLUTION:

Two special strips of Plugmold 3000, each with eight Twistlock receptacles, were prepared. One strip was located on the upper mold frame, the other on the lower as a power supply for the respective mold areas.

DISCUSSION:

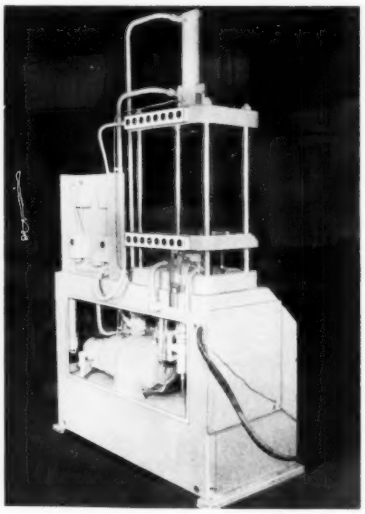
Together with engineers of the machinery manufacturing firm, Wiremold engineers designed strips of Plugmold 3000 to meet the requirements. This series was chosen as the one that best met the requirements because it accepted standard receptacles and had the necessary capacity.

The molds used in the machine are electrically heated, and having the power source directly on the press was thought to be an important convenience and safety factor since it would eliminate long wires going to the mold cavities. In addition, it was felt that this arrangement would permit greater flexibility in press placement.

In operation, flexible leads with Twistlock plug caps come from the heating coils in the molds and are plugged into the strips mounted on the press. The speckled finish is applied by the press manufacturer to match the finish on the machine.

One end KO on each strip is removed to permit the conductors to enter the raceway. The base is attached to the frame, but the cover is easily removable for necessary maintenance. The flexible leads were specified to permit the conductors to travel with the mold head.

Cooperation with equipment manufacturers has led to greater use of Wiremold products on original equipment. Wiremold engineers are pleased to assist in modifying existing products, or developing new ones, to meet special requirements.



Useful Literature

Check coupon on second page for copies of listed items.

Tele-Power Data Sheet

Complete information on the installation of a 3-run Tele-Power System in an engineering office. The system consists of one run of Plugmold 2000 and two runs of 2200, one for telephone; the other for PAX system. (A-14)

Branch Circuits in College Building

Use of Wiremold 3000 as the raceway system for the branch circuits required for the lighting as well as for the special purpose circuits is described in data sheet. Installation is at Oregon State College's new physics-chemistry building, Corvallis, Ore. (A-15)

Practical Tips

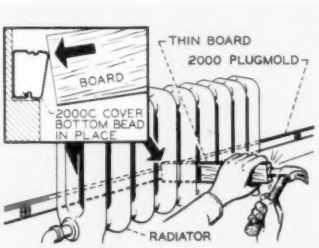
Behind-radiator installations made without removing radiator

Installing Plugmold behind radiators is easily accomplished without removing the heating devices by the use of two simple techniques developed in the field.

For short radiators, the cover and base are pre-assembled with the wiring inside. The base is extended beyond the cover to provide a means for fastening to the wall.

For long radiators, where there is sufficient space between the heat webs, install the base by reaching through with a long, magnetized or clutch type screwdriver. Then, snap wiring into the cover section and lay the assembly behind radiator.

With one man on each end of the radiator, engage the lower bead of the cover along the entire length. Working from one end to the other, close top beads. A short length of board held against the cover and rapped sharply will close the cover in places which cannot be reached by hand. To avoid hidden outlets, use jumpers with blank cover.



How to pick the right signal for the job

How long since you reviewed the signal equipment in your plant? Would you even know how to go about evaluating your signal requirements?

To help you evaluate your needs and select the proper equipment for your plant, the Benjamin Division of Thomas Industries has prepared a detailed bulletin for your use. The information below is typical of that found in this important bulletin. Just fill out the coupon below and send today for your free copy.

TYPES OF SOUND SIGNALS

MOTOR-DRIVEN TYPES

SIREN is recommended for fire alarm systems and similar, non-coding uses. It is particularly recommended for warning purposes where machine operation, etc., is extremely loud and a shrill tone is required.

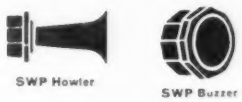
HOWLER is entirely weatherproof. It has an attention-compelling tone and is suitable for calling and warning systems either in the noisiest locations or where a large area is to be covered.

VIBRATOR TYPES—EXPLOSION-PROOF

EXH types withstand the tremendous pressures of internal explosion without breaking down, or permitting flame, hot gases, or sparks to escape.

EXH HOWLER has a powerful, penetrating tone which is suitable for calling and warning systems in certain hazardous locations.

EXB BUZZER has a distinctive tone for use in calling and warning systems in these same hazardous locations, but where competing noise is not excessive.



VIBRATOR TYPES—WEATHERPROOF

SWP types are designed with sealed construction. Howlers have a unique, high volume tone that cuts through average industrial noises and demands instant attention; buzzer tone is less penetrating. Both howlers and buzzers are suitable for calling and warning systems.

SWP HEAVY DUTY HOWLER meets requirements of most indoor and outdoor industrial and commercial areas having an average noise level.

SWP FIRE ALARM HOWLER meets stringent requirements of fire alarm operation.

SWP BUZZER has a different tone than a howler and is used in indoor and outdoor areas where competing noise is not excessive.

VIBRATOR TYPES—NON-WEATHERPROOF

SNP type howlers and buzzers have the same tonal qualities as corresponding SWP types and, like them, are suitable for both calling and warning systems.

SNP NON-WEATHERPROOF HOWLERS are for use in indoor industrial and commercial areas with an average noise level.

SNP NON-WEATHERPROOF BUZZERS are for use in similar areas where competing noise is not excessive.

BENJAMIN DIVISION
THOMAS INDUSTRIES Inc.
207 E. Broadway—Dept. AEC
Louisville 2, Kentucky

Send FREE copy of Bulletin K—Audible Signal Equipment to:

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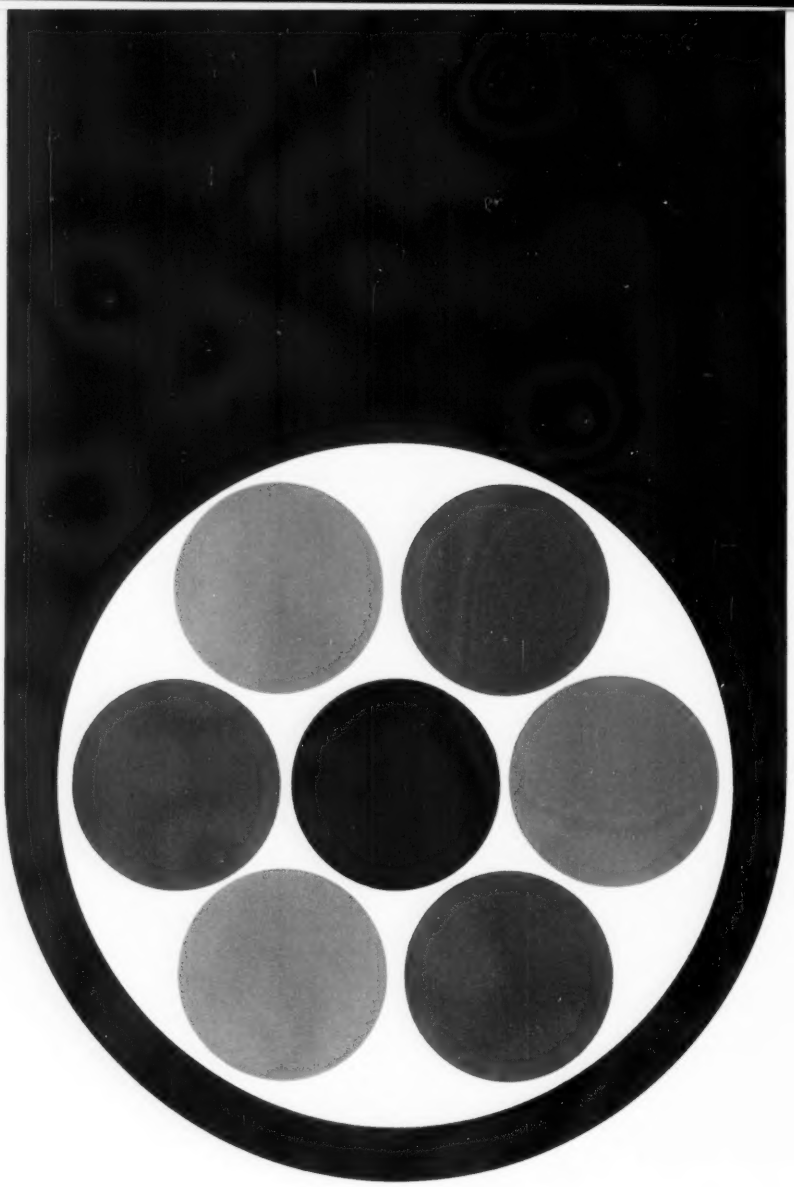


NEW WAY TO EVALUATE CABLE!

"VALUE RATINGS" RELATE PERFORMANCE TO IPCEA OR COMPETITIVE STANDARDS

New Value Ratings tell at a glance the composite story of each Kaiser Wire construction—as it performed in as many as 25 specified tests. In each case a well-known standard serves as 100%:

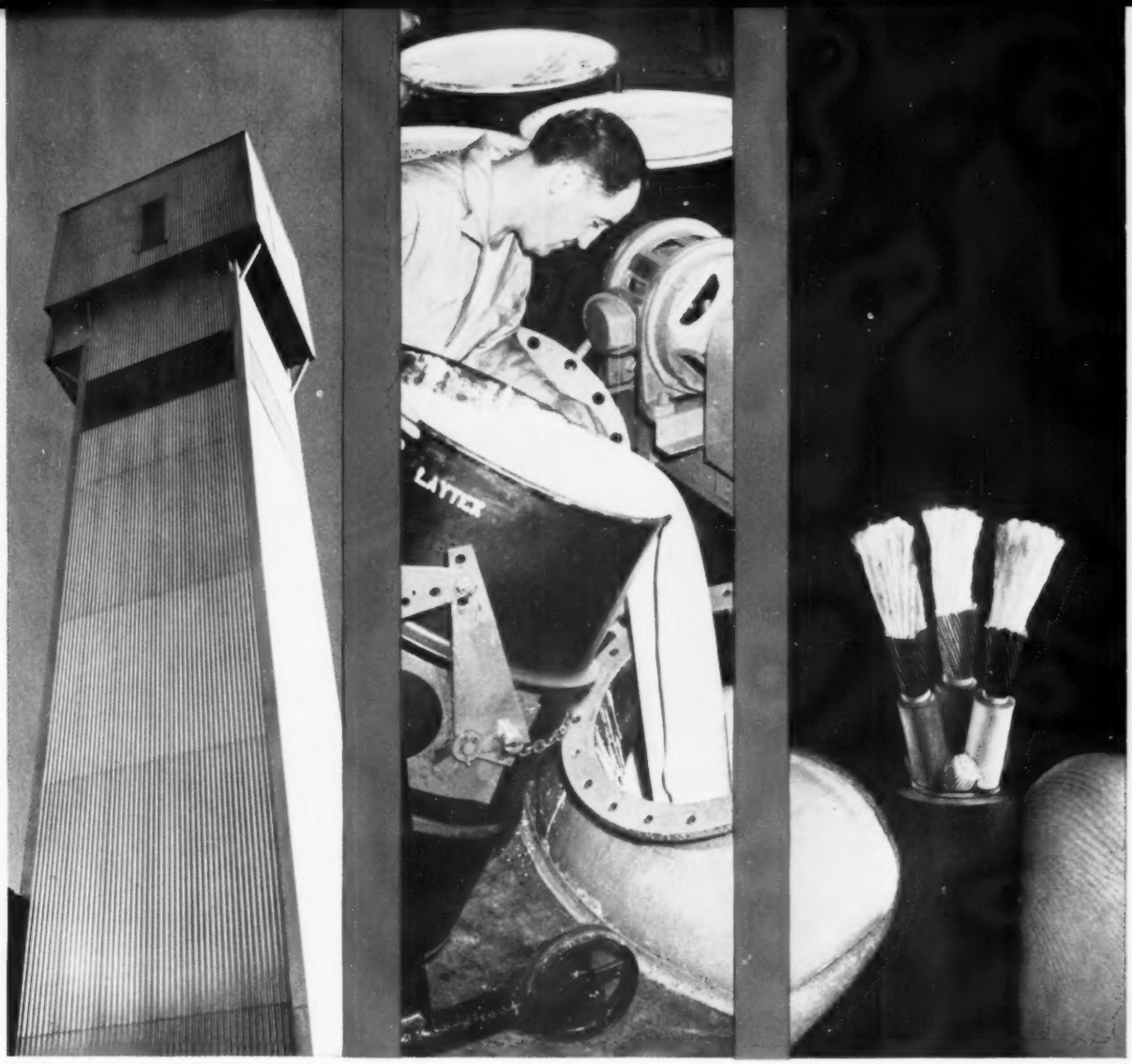
For power cable, the Value Rating standard is all IPCEA test requirements for types of insulation and jacketing specified... For portable cord, the standard is service-per-dollar for the least expensive cord (C.V.) as proved by life-expectancy tests.

... For control cable, the standard is a composite of minimum requirements for eight important insulation qualities.

Compared to these standards, Kaiser Wire constructions earn Value Ratings as large as 767%—valid proof that the spark of quality is Kaiser Wire experience.

For details and Value Rating listings, ask your Kaiser Wire Distributor for free K/W Value Rating Bulletins, or write: Kaiser Wire, Room 844g, Kaiser Aluminum & Chemical Sales, Inc., Kaiser Center, 300 Lakeside Drive, Oakland 12, California.

KAISER ALUMINUM & CHEMICAL CORPORATION



WORLD'S MOST MODERN VERTICAL C.V. UNIT TOWERS OVER OTHERS

The world's most modern . . . tallest . . . and largest vertical continuous-vulcanization line operates in a 126-foot tower at Kaiser Wire's Bristol, R.I., plant. It turns out K|W power cables ranging from 600 V. to 15,000 V.—with conductors dead center regardless of thickness or weight. It is topped by a six-inch rubber extruder . . . ends with a new high-pressure water cooling system that increases insulation density and improves corona level in K/W power cables.

K/W GRIZZLY® POWER CABLE SPEC. 831
VALUE 270% RATING

MIRACLE OF LIQUID LATEX GUARDS KAISER LAYTEX® CONTROL CABLES

Coat after coat of liquid latex—applied in 100-foot vertical runs—gives K|W Laytex-insulated control cables unequalled value. The patented Laytex insulation process is the only one that applies virgin liquid rubber with its "liveliness" untouched by drying-regrinding cycles. Vertically applied concentric coatings eliminate any chance of weak, thin spots. Vulcanized Laytex has a remarkable insulation resistance constant of 75,000; typical tensile strength of 4,500 psi.

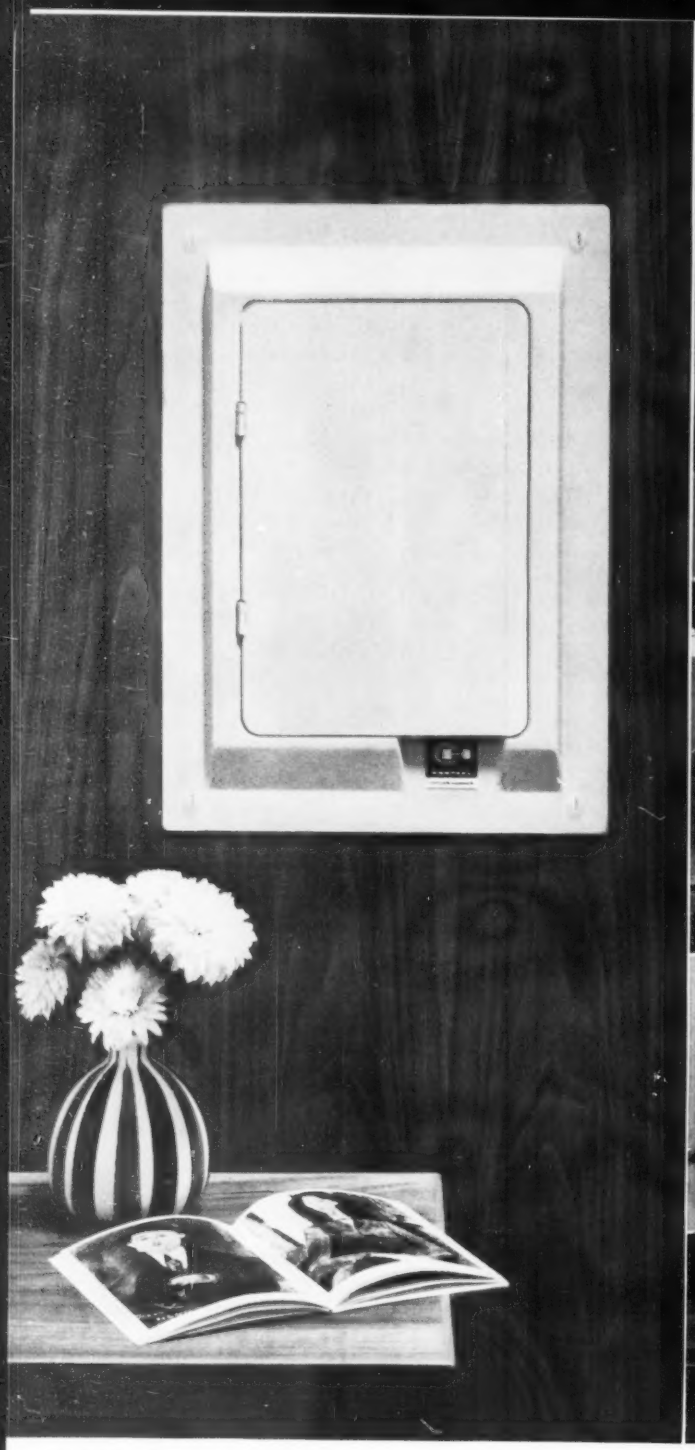
K/W LAYTEX-RESIN CONTROL CABLE
VALUE 767% RATING

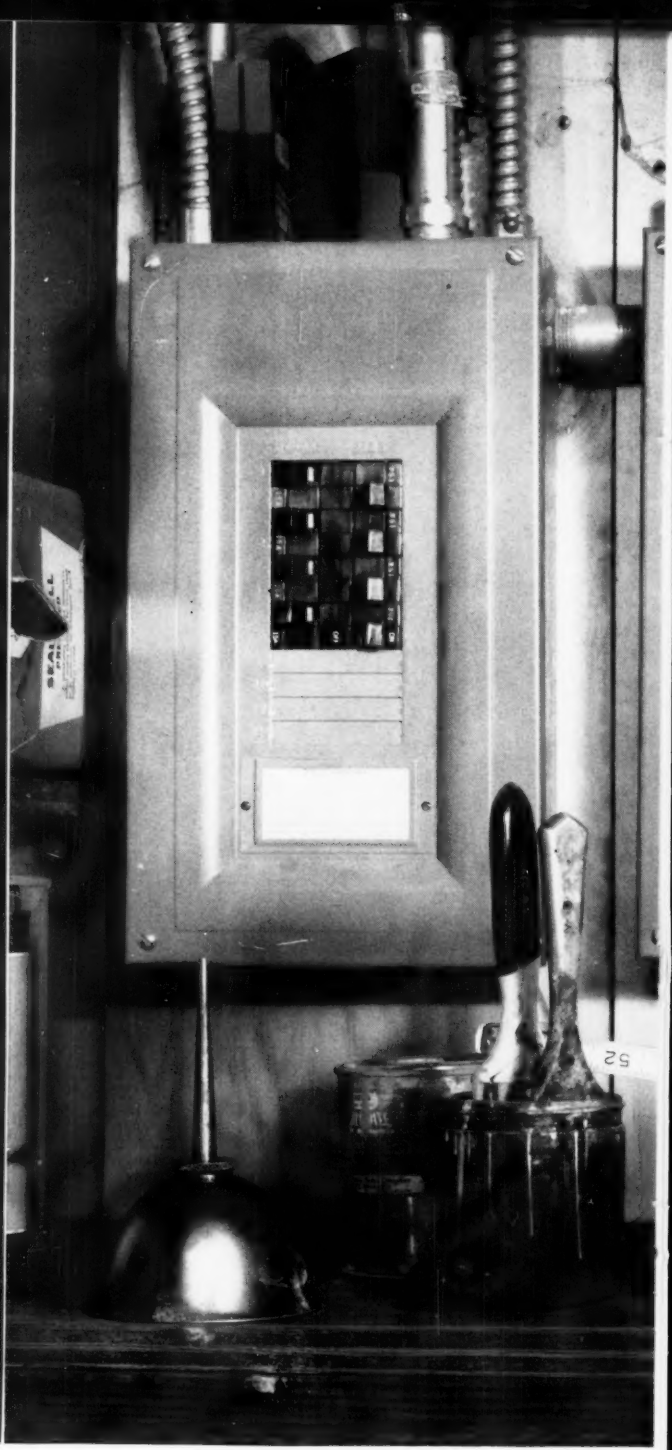
KAISER FIBROUS CORE HELPS THIS CORD FLEX 12 TIMES LONGER

A patented "cushion" core of soft fibre —at the center of the twisted copper conductor itself—is one reason why K|W Master Laytex portable cord survived 1270% more flexing cycles than the average low-priced product (C.V.) . . . 488% more than high-grade mold-cured competitive cords. Flexing is one of eight qualities adding up to *five times greater life* for K|W Master Laytex cord. In service per dollar this means 308% as much value as low-priced C.V.

K/W MASTER LAYTEX PORTABLE CORD
VALUE 308% RATING

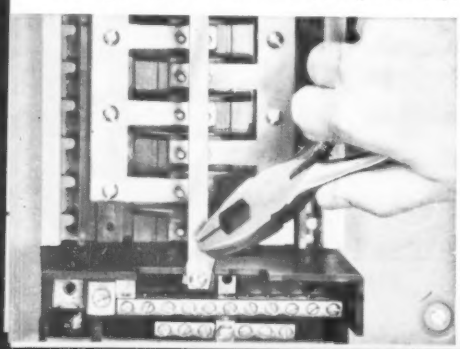
IN COPPER AND ALUMINUM CABLES...THE SPARK OF QUALITY IS KAISER WIRE EXPERIENCE! KAISER ALUMINUM



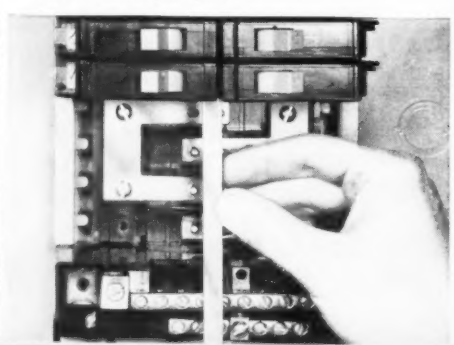


SIMPLEST, MOST FOOLPROOF N. I. SYSTEM BY FAR—NO SPECIAL TOOLS REQUIRED FOR INSTALLATION Simplified Safetybreaker system eliminates fussy keying systems, makes it impossible to incorrectly position tabs. Here's the Safetybreaker method:

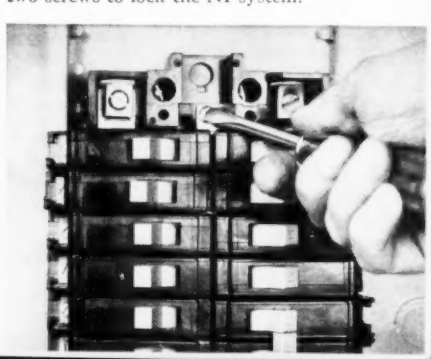
1 Simply tear off soft plastic spacers to loosen locking-bar screws, and let locking bar drop.



2 Plug in breakers in top portion of panel. Slide bar to top of panel.



3 Plug in remaining breakers. Tighten two screws to lock the NI system.



Why settle for an old-fashioned "basement gray" box?

Get this new, smartly-styled safetybreaker...it doesn't cost a nickel more

(and often costs less!)

Here's a bonus in beauty and protection that gives you—and your customers—extra features at no extra cost.

Modern appliance styling lets you show how good your wiring job is. This soft sandalwood finish *belongs* upstairs, convenient to the kitchen, saving you on those heavy wiring runs.

Eliminates housewife confusion and saves you unnecessary call-backs. Simple as a light switch, with easy-to-see "on" and "off" positions. There is no tripped mid-position to harass the homeowner, no calls for you to reset the breaker because the housewife mislaid or misread instructions.

Inside as superior as the outside. Won't rust, won't corrode because every operating part is either stainless steel or heavily plated. Double protection with magnetic trip for short circuits *and* bimetal trip for sustained overloads. Easier to install with plenty of wiring room, no knuckle-skinning wire guides.

Want to know more about Cutler-Hammer's New Safetybreaker? Write for free 36-page Safetybreaker Selection Guide. Better yet, see your Cutler-Hammer distributor and let him show you personally.

What's new at Cutler-Hammer? This new Safetybreaker is typical of the *better* products you'll be getting from Cutler-Hammer . . . results of new engineering talent . . . new facilities . . . a new creative atmosphere at every level.

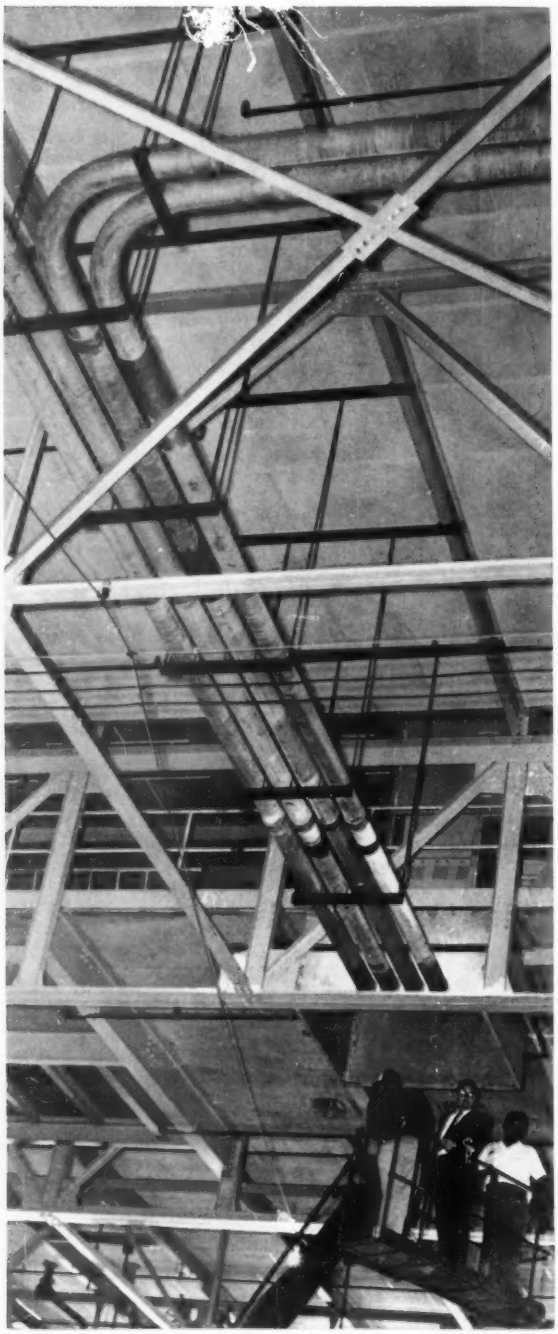
WHAT'S NEW? ASK...

CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Cutler-Hammer Canada, Ltd.; Cutler-Hammer Mexicana, S. A.

"Don't send a pony to do a horse's job"

A conversation you might hear around any good raceway.



Man with necktie: "WOW! It seems a lot higher once you're up here. Okay. Let's get this over with. Tell me. Why *steel* conduit instead of . . . ?"

White shirt: "Mainly because steel is stronger and gives us excellent protection against damage to conductors."

Work shirt: "It's easy to install. You can thread with regular dies, and you don't need special lubricants."

Necktie: "Well, that ought to do it. I just wanted a few facts to put in a report I'm making. Let's go back down and . . ."

Work shirt: "You don't have to baby steel conduit. You can bend it without worrying about it flattening out or crinkling."

Necktie: "Fine. Okay, let's get down off . . ."

White shirt: "Steel conduit can be installed in all atmospheric conditions and hazardous locations."

Necktie: "Well, that wraps 'er up. Let's go down and . . ."

Work shirt: "You don't have to give steel any special coating for concrete installations."

Necktie: "I've never been up on one of these things before . . . feel a little shaky . . ."

White shirt: "Steel conduit provides a grounded metallic system; induced currents are drained off without danger."

Necktie: "Let's go down."

Work shirt: "Steel conduit has a smooth interior . . . makes it easy to pull wires. Saves time and money."

Necktie: "Let's go down."

White shirt: "We wouldn't use anything *but* steel conduit here. You know . . . don't send a pony to do a horse's job. Okay. Want to go down?"

Necktie: "Yes . . . yes . . . steel conduit . . . certainly!"

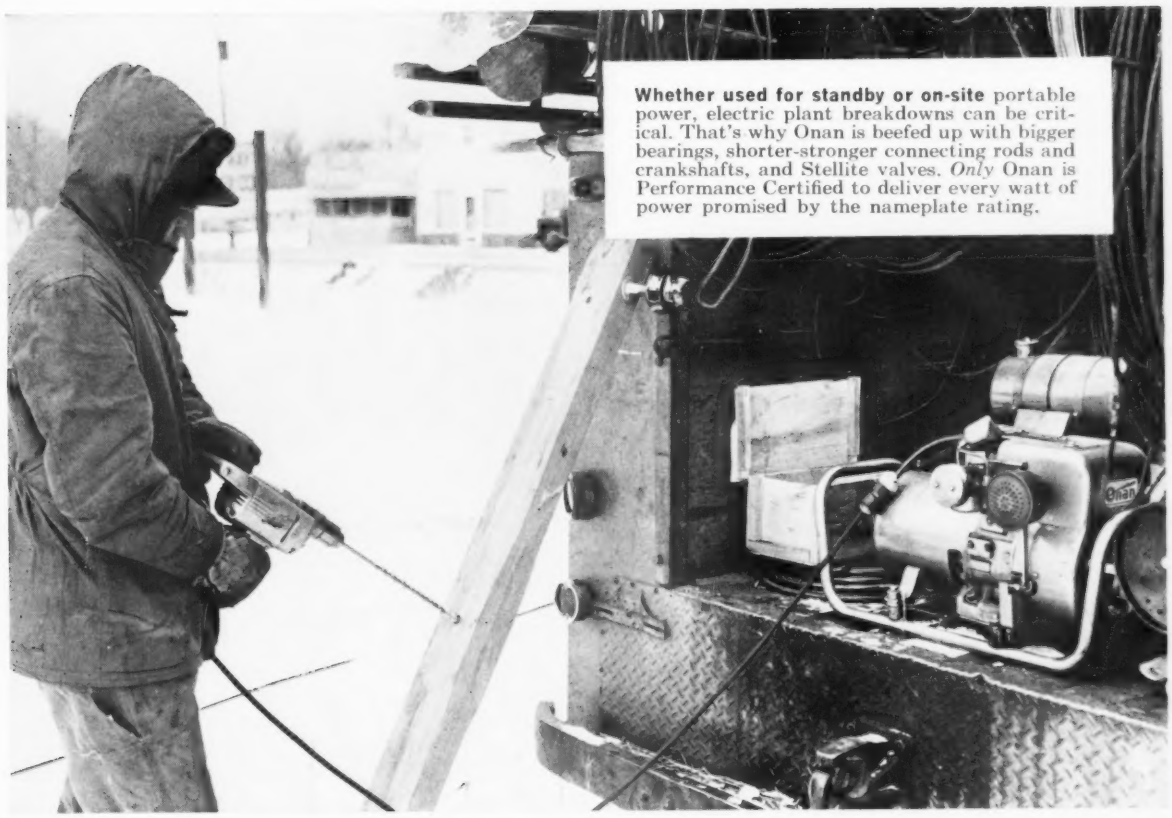
America's leading steel pipe manufacturer supplying America's foremost conduit manufacturers.

National Tube Division of United States Steel

USS TRADEMARK

This mark tells you a product is made of modern, dependable Steel.

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, Distributors Abroad



Whether used for standby or on-site portable power, electric plant breakdowns can be critical. That's why Onan is beefed up with bigger bearings, shorter-stronger connecting rods and crankshafts, and Stellite valves. *Only* Onan is Performance Certified to deliver every watt of power promised by the nameplate rating.

Only Onan is certified to give you all the power promised by its nameplate

It's a fact that many electric plants on the market today do not deliver the output promised by their nameplate rating.

Every Onan plant is given a rugged workout *under full load* before it is shipped—*your assurance* that the Onan you buy is ready for hard work the day you get it.

But this isn't enough. Independent laboratory inspectors pull surprise inspections to double-check our tests and testing methods. They pull a plant off the line, run it, stop it, load it, overload it, check and recheck. Their torture test gives positive proof of Onan's quality. End result: *Onan's exclusive Performance Certification* . . . your assurance of getting every watt of power you pay for.

So when you're tempted by an electric plant "bargain," make sure its nameplate rating is not "inflated." Be sure you're getting full measure for your money. Remember, *the electric plant that shortchanges you in power output is no bargain at any price!* Only Onan is Performance Certified to deliver everything the nameplate promises.

See Onan electric plants soon. Compare before you buy. You'll find your Onan distributor listed in the Yellow Pages. Call him or write direct.

PERFORMANCE CERTIFIED

We certify that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.

World's Leading Builder of Electric Power Plants

Onan

ONAN Division, Studebaker-Packard Corporation, 329 University Ave. S. E., Minneapolis 14, Minn.

Lamps last up to 12 MONTHS MORE

when fixture ballasts wear this emblem!

CBM Ballasts are checked by tests regularly at E.T.L.

It isn't magic . . . it is just that CBM specs assure ballast performance "tailored to the tube" . . . performance that's checked by ETL test. Hence Certified CBM Ballasts can *add* up to 2500 hours more lamp life (equal to 12 months service in one-shift operation). Other practical benefits that grow out of CBM specifications include high light output, positive starting, power factor correction and longer ballast life. And you get UL listing, too! It pays to insist on Certified CBM Ballasts when you specify or install fluorescent fixtures. Want to keep up on ballast developments? Ask us to send you CBM NEWS.

CERTIFIED BALLAST MANUFACTURERS, 2116 Keith Building, Cleveland 15, Ohio.

8-61

Participation in CBM is open to any manufacturer who wishes to qualify.

LEVITON QUALITY TALKS

Now I know what Leviton means when it talks quality... everything—but everything—in their products are made right in the Leviton plant.

Yeah, but what's that mean to me?

From a complete ceramics plant to a complete metalworking plant to a complete plastics plant to an automated assembly and quality control, Leviton manufacturers **everything**, insuring absolute quality in every device you install.

Mean to you? It means quality control, that's what. Why, I saw their test lab—they showed me a switch that tested OK over 5 million times.

Of course, not every Leviton device you buy is cycled 5 million times, but a visit to Leviton's quality control laboratory will convince you, beyond any doubt, that Leviton's specification grade will stand up under heavy duty usage far beyond normal device life.

Talked to an architect the other day — you should have seen his eyes light up when I took a Quiet Switch apart for him.

It's a real precision job inside, isn't it?

Leviton specification grade devices are built to last. The Quiet Switch, for example, has a one-piece phosphor bronze contactor that retains its elasticity through millions of cycles, and the contacts are of special heavy silver alloy. Use the coupon below; check one for yourself.

MAIL THIS CARD . . . for a Leviton Quiet Switch and New ABC Catalog

LEVITON QUALITY TALKS BUSINESS

LEVITON®

LEVITON MANUFACTURING CO., INC.
Brooklyn 22, N. Y.
CHICAGO • LOS ANGELES • MONTREAL, CANADA

Contact AMERICAN INSULATED WIRING CORP., Pawtucket, Rhode Island, a Leviton subsidiary, for a complete line of insulated wire and cable products.

123456

LEVITON MANUFACTURING CO., INC.
236 Greenpoint Avenue, Brooklyn 22, New York

I am interested in Leviton Quality —

☐ Please send me a Quiet Switch
☐ Please send me a Leviton ABC Catalog

We do the following kind of work _____

_____

Name _____

Title _____ Dept _____

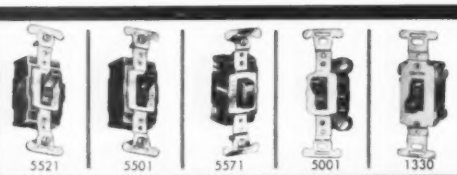
Company _____

Address _____

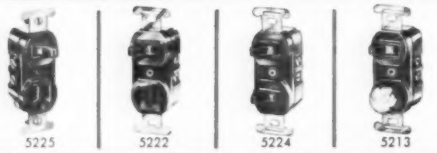
City _____ Zone _____ State _____

The most important wiring devices for any installation ...from

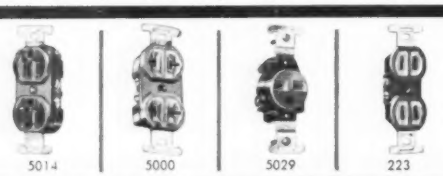
LEVITON®



Flush Tumbler Switches. Over 60 cataloged types are available, including specification grade 15 and 20 Amp AC Quiet, 10 and 20 Amp T-Rated AC-DC, and 10 Amp residential switches... backed by Leviton's reputation for superior quality at sensible prices.



Combination Line. Specification grade. Over 30 different cataloged combination duplex devices available. Quiet AC Switches combined with Parallel or U-Ground outlets, Pilot Light, or Duplex Switches in separate or common circuits. AC-DC switches in the same combinations.



Single and Duplex Receptacles. Over 40 different cataloged types. Single and Duplex U-Ground, T-Slotted, Tandem and Parallel, double contact, back and side wired, and Quickwire for heavy duty and residential uses.

Lev-O-Lock Devices. Specification grade, 2, 3, and 4 wire single and duplex receptacles, connectors, caps, and motor plug outlets. Midget 2 and 3 wire caps and cord connectors. For safety, dependability, economy.

When it's important for you to make a choice, you know there's a Leviton specification grade wiring device to fit your need. Ask your Leviton distributor today for your Contractor's ABC Catalog, or use the coupon below.

LEVITON QUALITY TALKS BUSINESS

LEVITON®

LEVITON MANUFACTURING CO., INC.
Brooklyn 22, N. Y.
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Contact AMERICAN INSULATED WIRING CORP., Pawtucket, Rhode Island, a Leviton subsidiary, for a complete line of insulated wire and cable products.

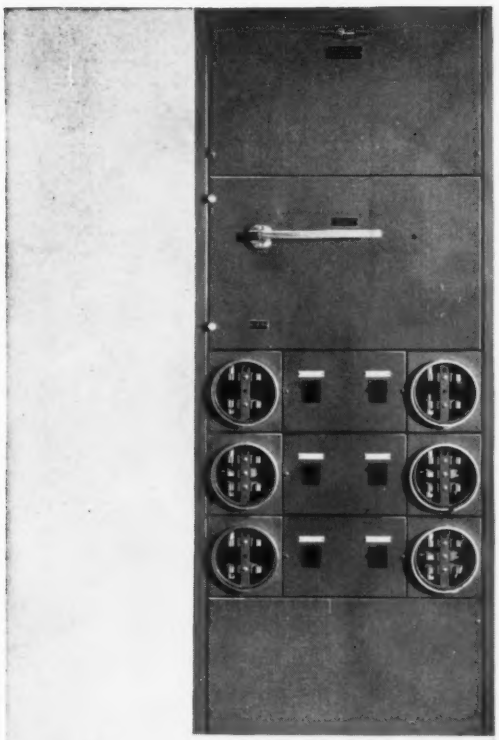
Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 21032, Brooklyn 1, N. Y.

LEVITON MANUFACTURING CO., INC.
236 Greenpoint Avenue,
Brooklyn 22, New York

MAIL THIS CARD... for a Leviton Quiet Switch and New ABC Catalog

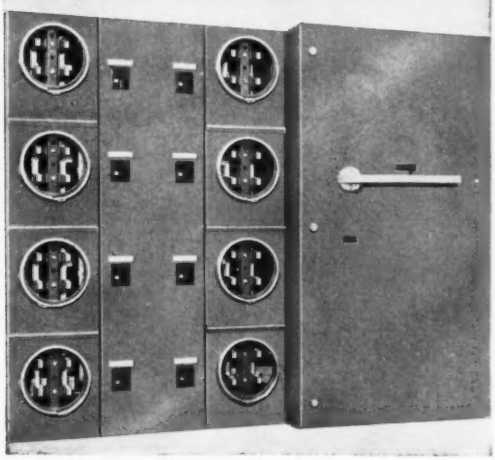


Uni-Power METERING SWITCHBOARD

▪ Island Type ▪ Allows meter installation front and back ▪ Factory-assembled and shipped to the job site

EQ METER MASTER

▪ Wall Mounted ▪ Takes up less space on walls ▪ No "pull box" needed ▪ Factory-assembled and ▪ **stocked by distributors**



I-T-E

METERING SYSTEMS

CROSS BUSSED

TO GO UP QUICK!

SAVE

TIME, WIRING, WORK!

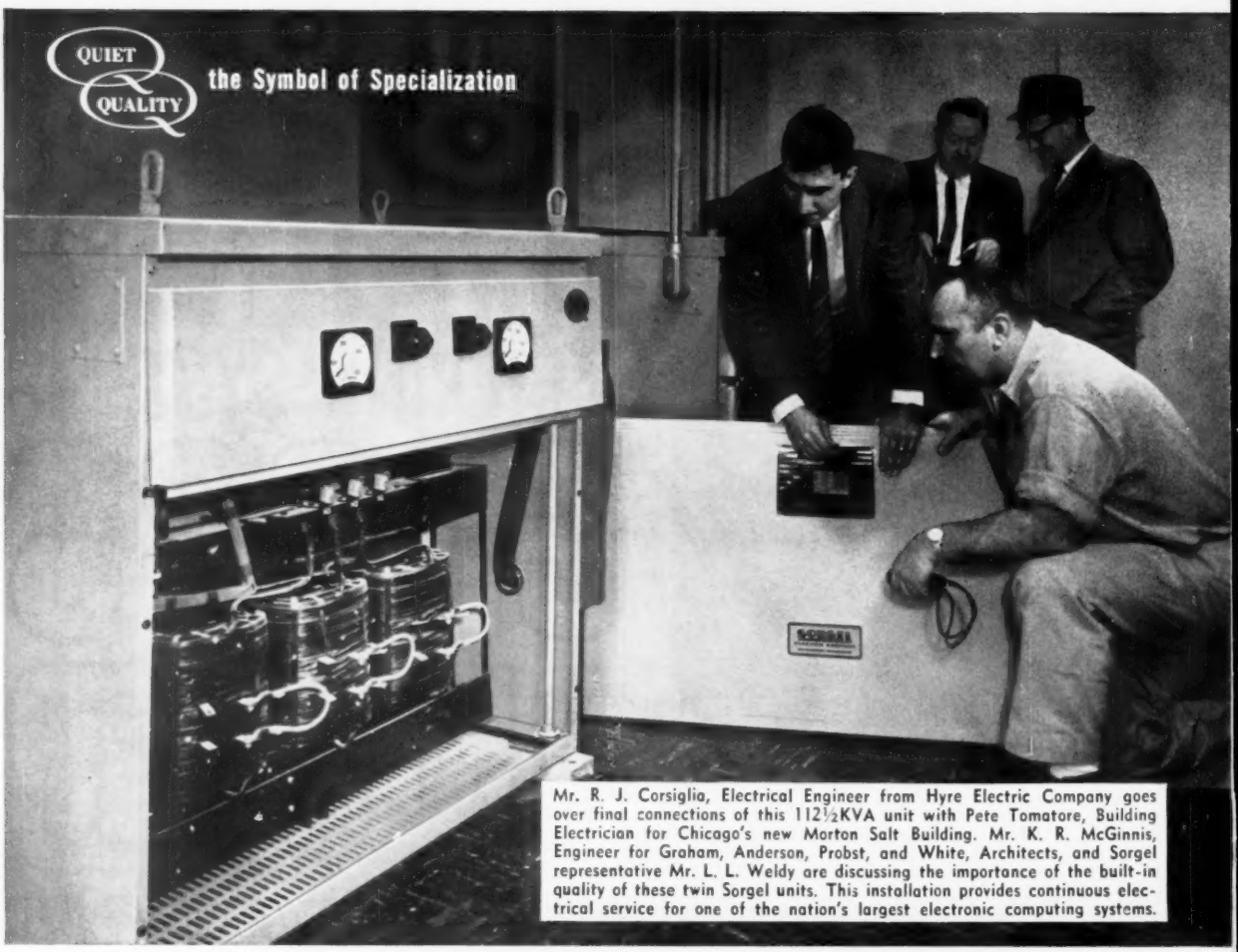
Specify I-T-E! These famous-quality Metering Systems are *complete devices!* I-T-E does the cross-bussing in the plant so you don't have to wire on the job! Result? Faster installation . . . lower materials cost . . . plus a remarkable savings in time! INSTALLATION IS SIMPLE: You merely *wire in service* to the switch . . . and *wire out* from the breakers! Get full details. Write I-T-E Circuit Breaker Company, Walker Division, 125 Bennett Street, N. W., Atlanta 9, Georgia. Ask for Bulletin 761.

I-T-E CIRCUIT BREAKER COMPANY

WALKER DIVISION

QUIET QUALITY

the Symbol of Specialization



Mr. R. J. Corsiglia, Electrical Engineer from Hyre Electric Company goes over final connections of this 112½KVA unit with Pete Tomatore, Building Electrician for Chicago's new Morton Salt Building. Mr. K. R. McGinnis, Engineer for Graham, Anderson, Probst, and White, Architects, and Sorgel representative Mr. L. L. Weldy are discussing the importance of the built-in quality of these twin Sorgel units. This installation provides continuous electrical service for one of the nation's largest electronic computing systems.

SORGEL HAS A DRY-TYPE

1/4 KVA TO 10,000 KVA, ALL STANDARD AND INTERMEDIATE VOLTAGES UP TO 15,000 VOLTS

Unit above is typical of construction for ¼ KVA up to 7½ KVA sizes. Popular sizes up to 75 KVA both single and 3-phase transformers are normally in factory stock.

Stock units, such as 75 KVA shown here, are shipped on day order is received. All sizes up to 75 KVA are constructed to be interchangeable for floor or wall mounting.

HERE'S WHY SORGEL TRANSFORMERS MEAN DOLLARS AND SENSE TO YOU

Sorgel equipment installs easier, provides unusual reliability, and operates economically at high efficiency

More and more Sorgel dry-type transformers are being installed daily in new or modernization construction for schools, shopping centers, hospitals, industrial plants and office buildings of all sizes. Here's why: Contractors prefer Sorgel primarily because of their easy installation and reputation for quality. Enclosures are self-supporting. Entrance can be made on sides, top, bottom or back. Solderless connectors speed up terminal wiring, as does roomy compartment.

Consulting and plant engineers insist on Sorgel quality because of high efficiency, and a fully rated load operating continuously at a safe temperature.

Direct advantages of Sorgel equipment to all buyers include lower copper loss, lower core loss and the lowest sound levels available. Sorgel continuously provides the most liberal designs and a coordinated system of either Class B, F, or H insulation with effective use of quality materials throughout each transformer produced. Take advantage of this unique combination of experience and engineering skills by insisting on Sorgel quiet quality transformers.

SORGEL
SOUND-RATED DRY-TYPE
TRANSFORMERS

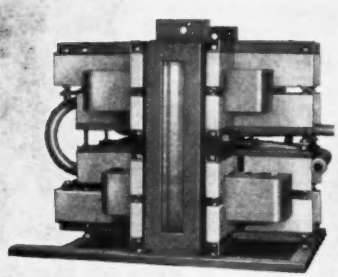
SORGEL ELECTRIC COMPANY

Since 1916 the pioneer in the development, manufacturing and application of sound-rated dry-type transformers

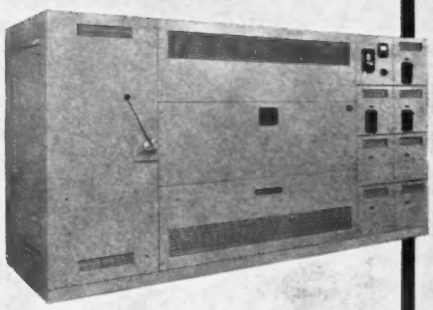
836 WEST NATIONAL AVENUE • MILWAUKEE 4, WISCONSIN

Experienced sales engineers in principal cities

TRANSFORMER FOR YOUR EVERY NEED



This electrical magnetic pump transformer, used with fluid lithium, is an example of Sorgel's engineering abilities to handle tough customer designs.



This 2,000 KVA, 3 phase, 13,200 volt, unit is typical of Sorgel load centers. These units are procurable with any type or make of switch gear.

CLIP AND MAIL FOR TECHNICAL BULLETINS.

- ☐ 611—Transformer Line
- ☐ 960—Sub-stations
- ☐ 658—DC Saturable Reactors

Name_____

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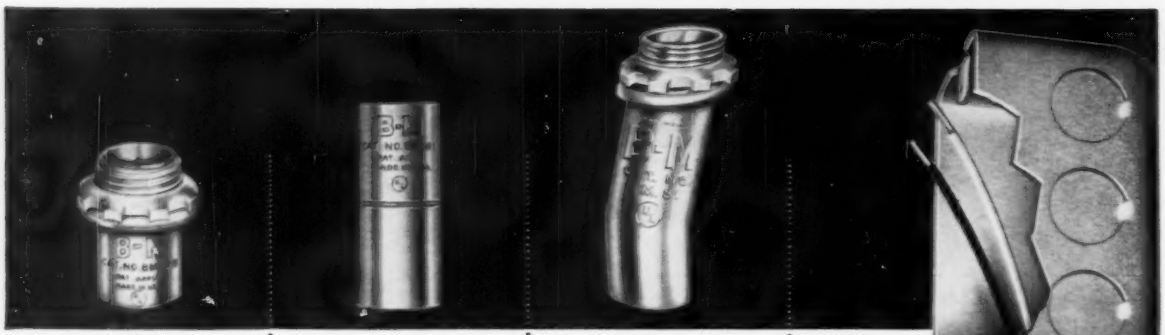
City_____

State_____



Red Throat
BM-21B
½" Connector
BM-22B
¾" Connector
BM-23B
1" Connector

BM-41
½" Coupling
BM-42
¾" Coupling
BM-43
1" Coupling

BM-51
½" Offset Connector
BM-52
¾" Offset Connector

BM Offset Connectors showing how wires are guided over box edge.

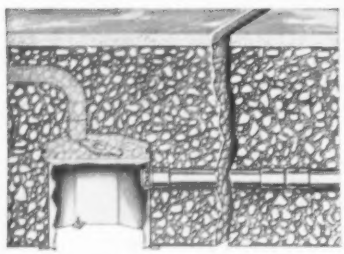
FOR MORE PROFITS

Save time and money with

B-M ORIGINAL INDENTER FITTINGS

Here is the combination that is unbeatable when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws.

A few more of the plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.



ALL BRIEGEL FITTINGS ARE U. L. APPROVED AS CONCRETE-TIGHT

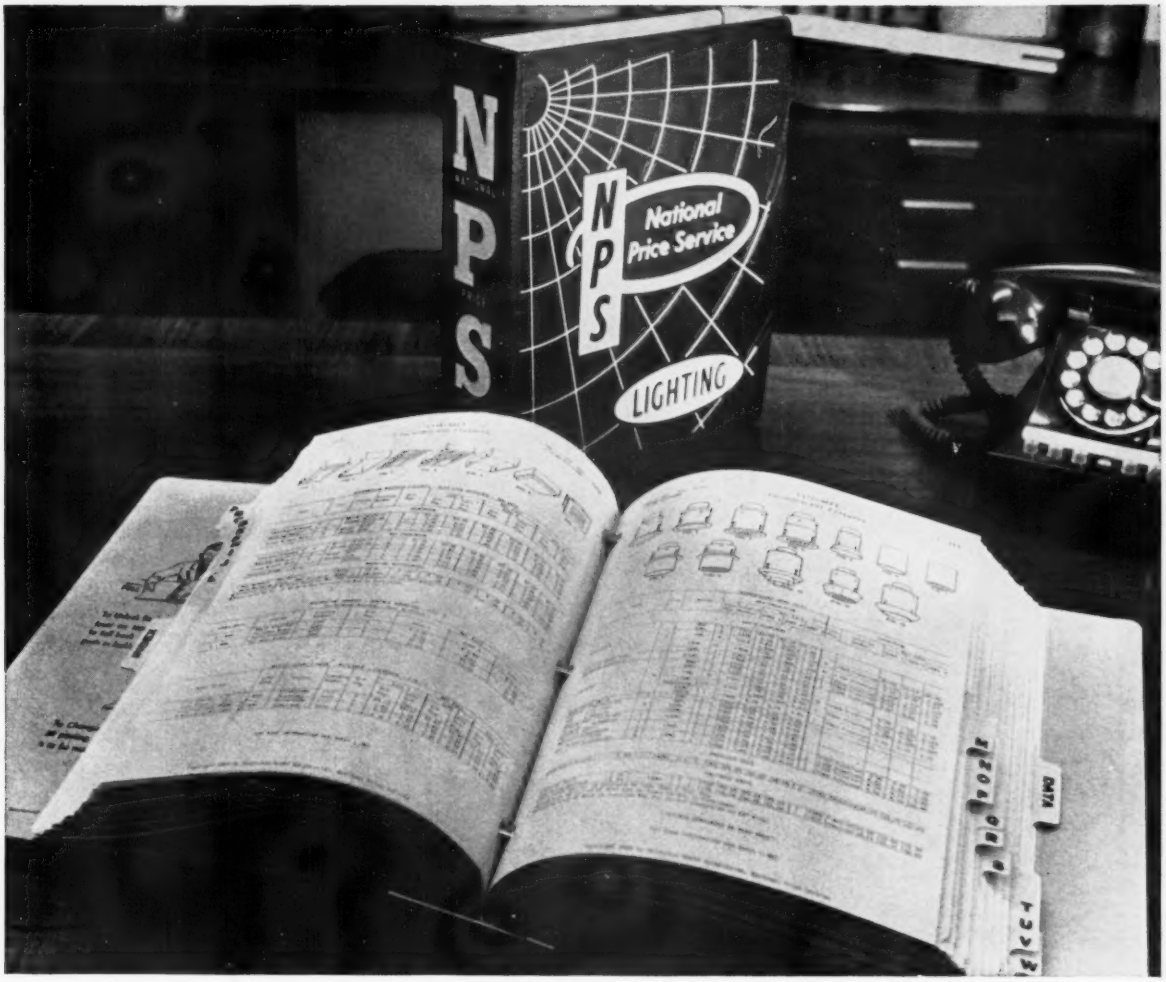
When setting E.M.T. in concrete you can make each job easier and more profitable by using Briegel All Steel Indenter Fittings that have UL approval as Concrete-Tight. Contractors everywhere recognize their cost cutting qualities and the fact that they make each wiring job a better job. It is only natural that Briegel Fittings are the most widely used E.M.T. connectors and couplings.

BM PLIER SIZE INDENTERS
BM—No. 607 ½"
BM—No. 608 ¾"
BM—No. 609 1"

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

BRIEGEL METHOD TOOL CO.
GALVA • ILLINOIS

USED THE MOST FROM COAST TO COAST



This is LIGHTING

An entire price book devoted exclusively to commercial and industrial lighting equipment, including fluorescent and incandescent fixtures, floodlighting and accessory equipment. It is completely illustrated, kept up to date continuously and is a tremendous timesaver for those who estimate, buy, sell or quote lighting.

Use the coupon to obtain complete index, sample sheets and application form ... without obligation.

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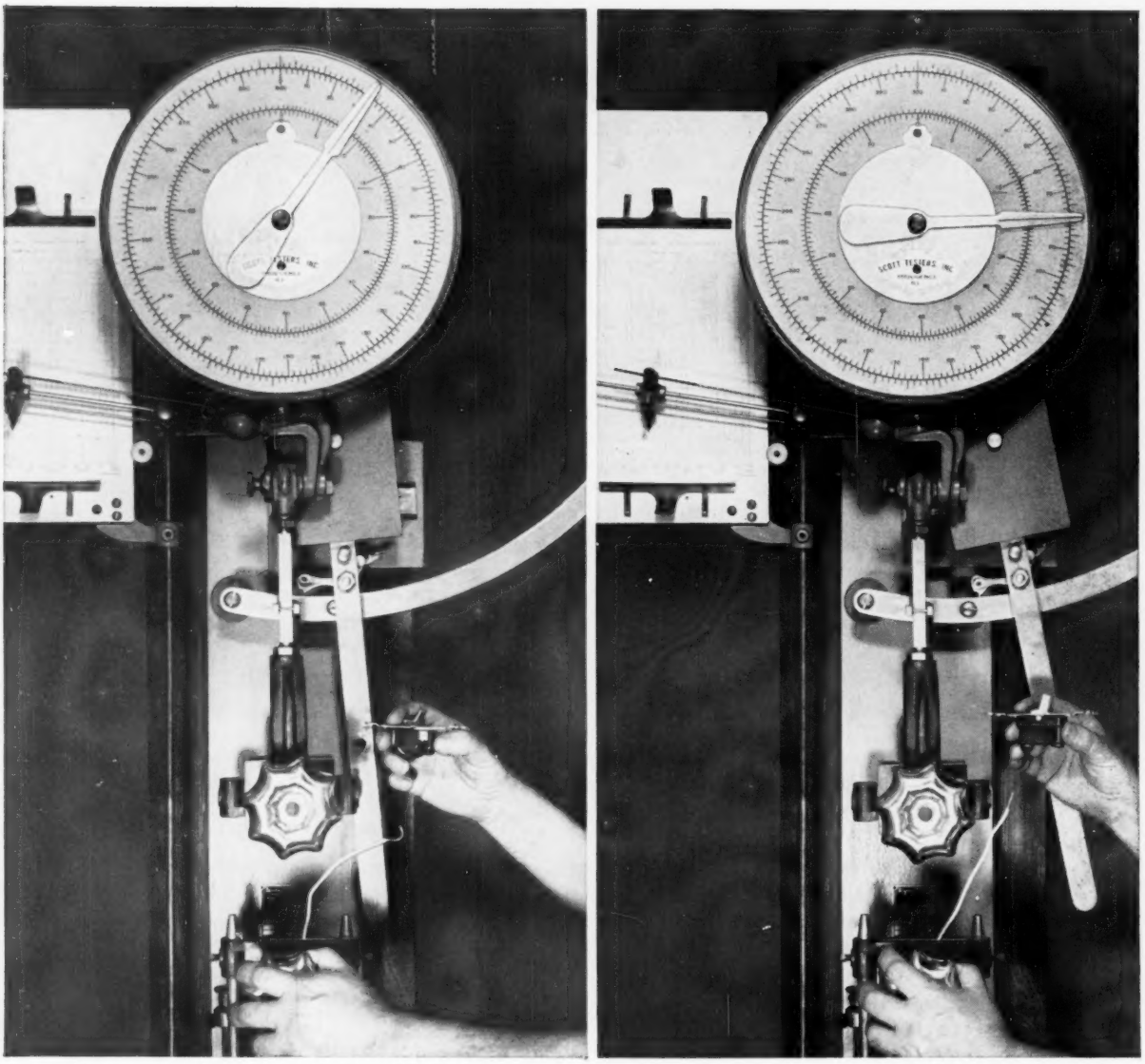
Laboratory tests prove General make better connections



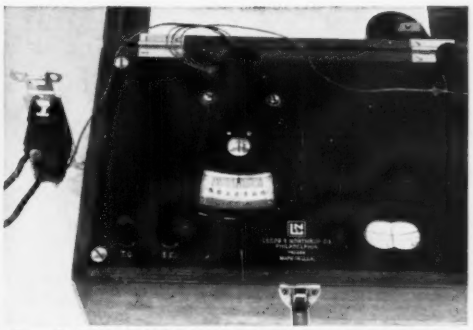
1. Better mechanical connections — This testing machine shows that a wire can be pulled out of an average binding screw connection (in left photo) by a force of about 30 pounds. Yet a G-E Pressure-Lock* terminal (in right photo) is good for 80 pounds! You can see the tight Pressure-Lock grip is more than adequate for any wiring job.

General Electric recommends its 135 switches, outlets and lampholders with Pressure-Lock terminals for the most modern, tight wire connections. Of course, it offers a complete line of wiring devices with binding-screw and clamp-type terminals, too.

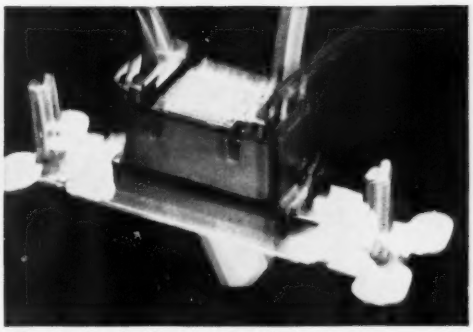
Ask your General Electric distributor to show you the many new ideas — the extra-quality features and the wide choice of wiring devices that you get in the complete G-E line. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

*Registered trade-mark of General Electric Company

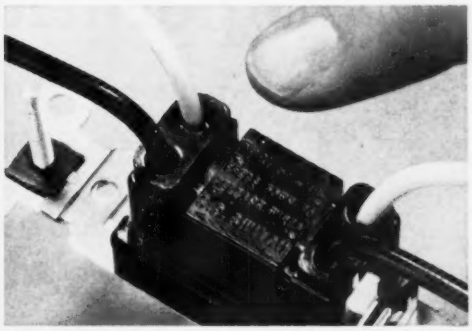
Electric Pressure-Lock Terminals than binding screws!



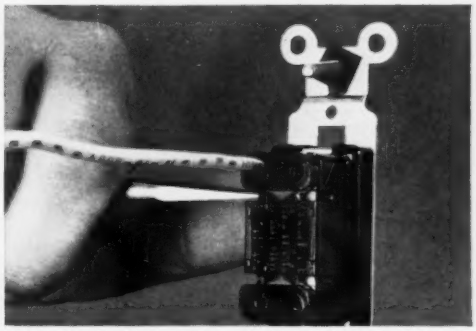
2. Better electrical connections — The temperature rise in a Pressure-Lock connection carrying 15 amperes is only 8°C — way below the U. L. allowed limit of 30°C! Humidity and salt do not affect this fine connection.



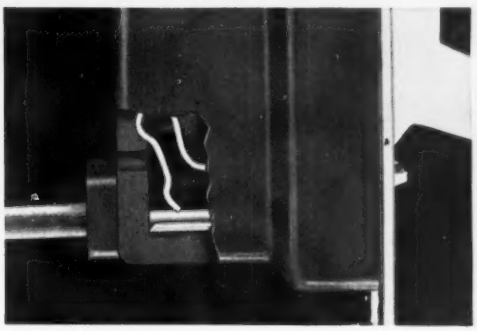
3. Longer-lasting connections — Pressure-Lock connections won't loosen under temperature changes or vibration the way screws do. And of course there is never any trouble with stripped threads, either.



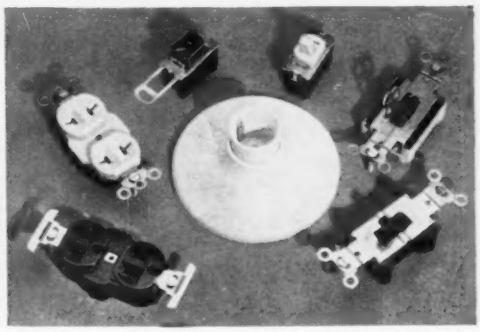
4. Extra safety — Notice that back-wired Pressure-Lock terminals are totally enclosed, to protect against grounds and shorts. And, they don't bend or loosen when you press the device back into a box.



5. Easy release when desired — New, wide release slots permit convenient release of wires by pressing with regular-sized screwdriver. They also make handy contact points for ring-out testing.



6. Strong steel spring locks wire in tight grip, carries no current. Wire is cupped in long, smooth contact channel, for an excellent electrical connection.



7. The proven performance of pressure terminals has led to their use in a whole series of G-E wiring devices, as well as in telephones, elevators, power distribution.

Progress Is Our Most Important Product

GENERAL ELECTRIC

JOB-PROFIT TOOLING IDEAS

FROM GREENLEE

New lightweight Wire Puller for fast one-man operation

- **WEIGHS ONLY 29 LB**
- **TWO-SPEED WINCH . . . 3 TO 1 AND 9 TO 1 RATIOS . . .**
- **PATENTED RATCHET ACTION**

Easily carried and operated by one man, the new GREENLEE No. 766 Wire Puller requires only 30-lb handle pressure to pull 1500 lb. Wire can be pulled at any angle from large or small outlet boxes or from the end of exposed conduit. At all times the pull is in line with the conduit . . . no strain on the hanger or outlet box. No loose cable to contend with . . . reel holds 200 feet of aircraft steel cable. Patented winch ratchet action . . . open-side pulley support for easy access to any outlet box. Typical performance: Large Midwest contractor reports pulling four strands of 4/0 wire through 165 feet of 2½-inch conduit with two 90° bends. Time, *20 minutes.*

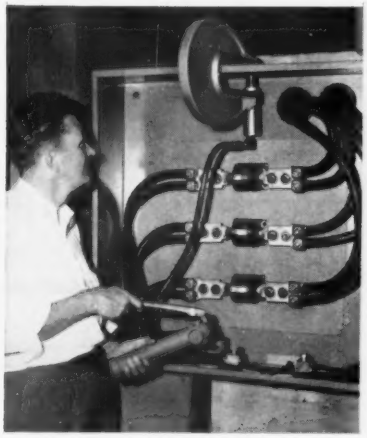
For large-size cable pulling use Greenlee No. 765 Cable Puller

ONE-MAN OPERATION • 7500 LB PULL • TWO OPERATING SPEEDS

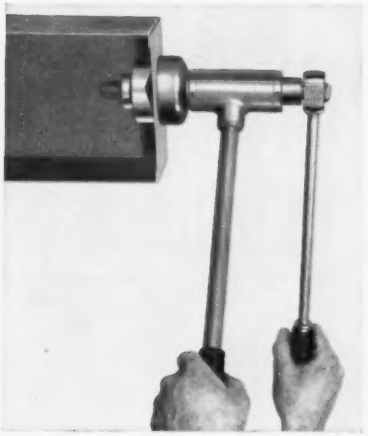
Portable . . . easy to set up and operate. Use it on exposed or concealed conduit. Pull is in line with the conduit with no strain on the hangers or outlet boxes. Can be equipped with flexible elbow attachment for pulling from concealed conduit . . . permits placing puller at any desired distance from end of conduit.

Hand and power drivers for knockout punches

Greenlee No. 7646-A hydraulic knockout punch driver develops 11 tons' ram force to easily drive punches through 10-gauge metal . . . cuts ½″ thru 5″ conduit openings in seconds. Many times faster than wrench method . . . can be used in cramped quarters. Timesavings quickly pay for this efficient tool. Designed to drive all Greenlee knockout punches. It is available singly for punches already owned or is available in sets with 6 or 10 punches.

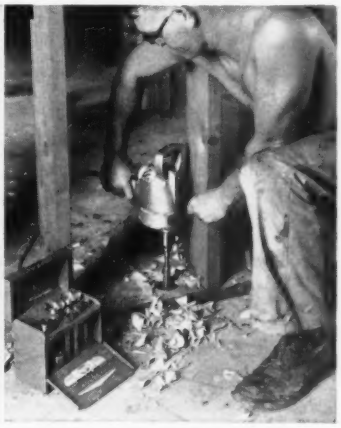


Greenlee one-shot knockout punch drivers are fast, lightweight, and powerful . . . easily operated by one man. Require no pre-drilling or step-up punching to make conduit openings . . . high-strength aluminum "C" frame. Punch cuts through 10-gauge steel with ease. Two sizes: No. 1731 to punch holes for ½″, ¾″, 1″ conduit and No. 1732 to punch holes for ½″ thru 4″ conduit. Hand or power pump operated.



Greenlee ratchet knockout punch driver makes conduit openings 6 to 8 times faster than with wrench method. Easily operated in any position. Use with standard Greenlee knockout punches from ½″ thru 3″. Available singly or with set of punches for ½″ thru 2″ conduit.

Greenlee makes a complete range of knockout punches for 1/2" thru 5" conduit . . . fast, easy cutting through 10-gauge metal . . . clean, accurate holes.



Fast-boring Greenlee bits for electrical work

Jobs go smoother when you standardize on Greenlee precision-made boring tools. Power drill and hand brace types . . . various styles and lengths for all types of electrical work. Electricians' auger bits, bellhangers' drills, solid-center auger bits, expansive bits, ship augers, pipe bits, spade-type power bits. Highest quality for fast, accurate boring and long life under hard usage.

Hand ratchet benders

Fast, easy way to make bends up to 90° in ½″ thru 1½″ rigid conduit. Greenlee ratchet bender is self-contained and easily portable. Ratchet action for short, powerful strokes . . . easy-to-reach ratchet release . . . built-in 0° to 90° bending gauge . . . swing-away pipe clamp for easy removal of 90° bend . . . direct handle operation for quick bending of small pipe. No. 1800 for ½″, ¾″, 1″ conduit. No. 1801 for 1¼″ and 1½″ sizes.

WRITE FOR CONDENSED CATALOG E-240A. GREENLEE TOOL CO., 1954 COLUMBIA AVE., ROCKFORD, ILLINOIS

TOOLS FOR CRAFTSMEN

GREENLEE

JOB-PROFIT TOOLING

. . . cost control for contractors

Combining Lighting and Air Conditioning from One Efficient Unit....

Sylvania Sylva-Flo Troffers with Multi-Vent combine the functions of Air Conditioning and Lighting in the offices of Chicago and Northwestern Railway in Chicago's Riverside Plaza Building. All Sylva-Flo Troffers handle air—either supply or return—for peak performance.

DATA AND HIGHLIGHTS OF SYLVANIA SYLVA-FLO INSTALLATION

Name of Installation	Riverside Plaza Building, Chicago
Size of Installation	26 Floors (536,000 sq. ft.)
Number of Sylva-Flo units	Over 10,000
Function of Sylva-Flo Troffers	Lighting, Cooling, Temperate Heating
Ceiling Type	Metal Pan Acoustical
Ceiling Height	8′ 0″
Lamps per Troffer	Two 40-watt Rapid Start, Cool White
Shielding	Skytex Glass
Troffer Spacing	7′ 0″
Number of "Supply" Troffers / Number of "Return" Troffers	Ratio is approximately one "Supply" to one "Return."
Average Lighting Level (Measured)	70 Footcandles
Air handled by each unit	Interior units—72 CFM; Perimeter units—80 CFM
Architect-Engineer	Graham, Anderson, Probst & White, Chicago
Architect	William Heinkel
Mechanical Engineer	John Maras
Electrical Engineer	K. R. McGinnis
General Contractor	Sherman Olson Inc., Chicago
Electrical Contractor	Hyre Electric Co., Chicago
Mechanical Contractor	O. A. Wendt, Chicago

Sylvania's SYLVA-FLO Troffer with Multi-Vent to Provide All-Round Comfort for 25,000 Persons in Chicago's RIVERSIDE PLAZA OFFICE BUILDING

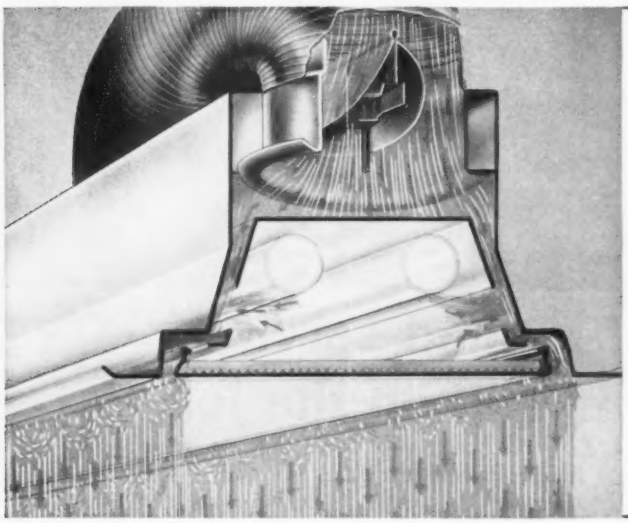
Occupants of Chicago's newly-remodeled Riverside Plaza will work in a quiet, well-lighted, comfortable atmosphere . . . thanks largely to Sylvania's Sylva-Flo Troffers with Multi-Vent. The 26 floors of this handsome office building will have lighting and air conditioning provided by Sylvania's efficient, attractive combination troffers.

All persons concerned with this installation have expressed satisfaction with the Sylva-Flo Troffers—the architect-engineer because of the appearance and effect in the completed offices; the contractors for the ease of installation and balancing air; and the building owner because of the economical cost and the all-round 'fresh air' comfort and balanced lighting.

Use this installation as a guide and check into the advantages of Sylvania's Sylva-Flo Troffers for your next new or remodeling project. Ask to see a sample unit. See for yourself the special features that make this fixture so advantageous from the standpoint of architect, engineer, contractor and user.

These features are completely discussed and illustrated in our new 20-page "Sylva-Flo" booklet. For your free copy, simply write to:

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, West Virginia



SYLVANIA'S SYLVA-FLO TROFFER PROVIDES THESE ADVANTAGES IN ANY INSTALLATION

- The combination of quality lighting and air-handling.
- As much as 20% more light output.
- *Superior* air conditioning with the Multi-Vent System.
- Longer ballast life.
- Truer lamp color.
- Clean, uncluttered ceiling.
- Twin panels of soft light blend combination troffer with ceiling.
- Less maintenance.
- Quiet operation.
- Flexible, low-cost installation.
- Economical operation.
- Simple adjustment.
- Choice of shielding.
- Versatility of troffer widths and lengths.
- Selection of troffer housing to fit ceiling type.

SYLVANIA

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GENERAL SYSTEM

Cutaway section of Sealtite® conduit showing tough BAKELITE vinyl jacket over flexible metal core. Conduit manufactured by Anaconda Metal Hose, Waterbury, Conn.

After eight years of rugged service this flexible conduit is still on the job

BAKELITE® vinyl jacket offers as much protection as ever!

"Sealtite" moisture-proof flexible conduit was specified to safeguard the power lead-in cable of this motor against the rugged operating conditions of a paper mill. At this critical point in the electrical system, a tough outer conduit jacket of BAKELITE vinyl provides extra protection against dirt, moisture, chemicals, abrasion and vibration. Today, after more than eight years of continuous service, the vinyl jacketed conduit is still in perfect condition!

The outstanding physical and electrical properties of BAKELITE vinyl offer similar protection as insulation for THW building wire. For this application, BAKELITE vinyl insulation provides a safety factor against heat generated by overloads and high environmental temperatures . . . and contributes to ease and economy of installation.

For more information on why quality BAKELITE vinyl is being specified and used for both flexible conduit and THW building wire, write Dept. JZ-41H, Union Carbide Plastics Company, Division of Union Carbide Corp., 270 Park Avenue, New York 17, New York. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE

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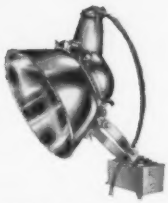
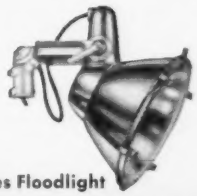


2000 Series Floodlight

3800 Series Floodlight



4200 Series Floodlight

199-D Series Hinged Pole

560 Series Rigid Pole

115 Series Rigid Pole

Revere's wide line of fixtures lets you light sports areas the one best way for each job

You don't have to shop around for components required to light outdoor sports areas the one best way for each application. Just plan your work the way you know the job should be done, then call on your Revere wholesaler. Whatever outdoor lighting equipment your plans call for, he can supply it from Revere's complete line, without substituting components which may be less than best for the job.

Whether you need hinged or rigid poles . . . mercury, incandescent or fluorescent luminaires . . . floodlights, fixtures and fittings—Revere has them all, *structurally* matched for strength, balance and perfect fit; *design* matched for peak lighting efficiency and best appearance. Installation is fast, easy, trouble-free.

Ordering all equipment from your Revere wholesaler simplifies paperwork and assures delivery of all components to your job site according to your construction schedule. See him about Revere fixtures for your next job. Write to us for a catalog showing Revere's complete line of outdoor lighting equipment.

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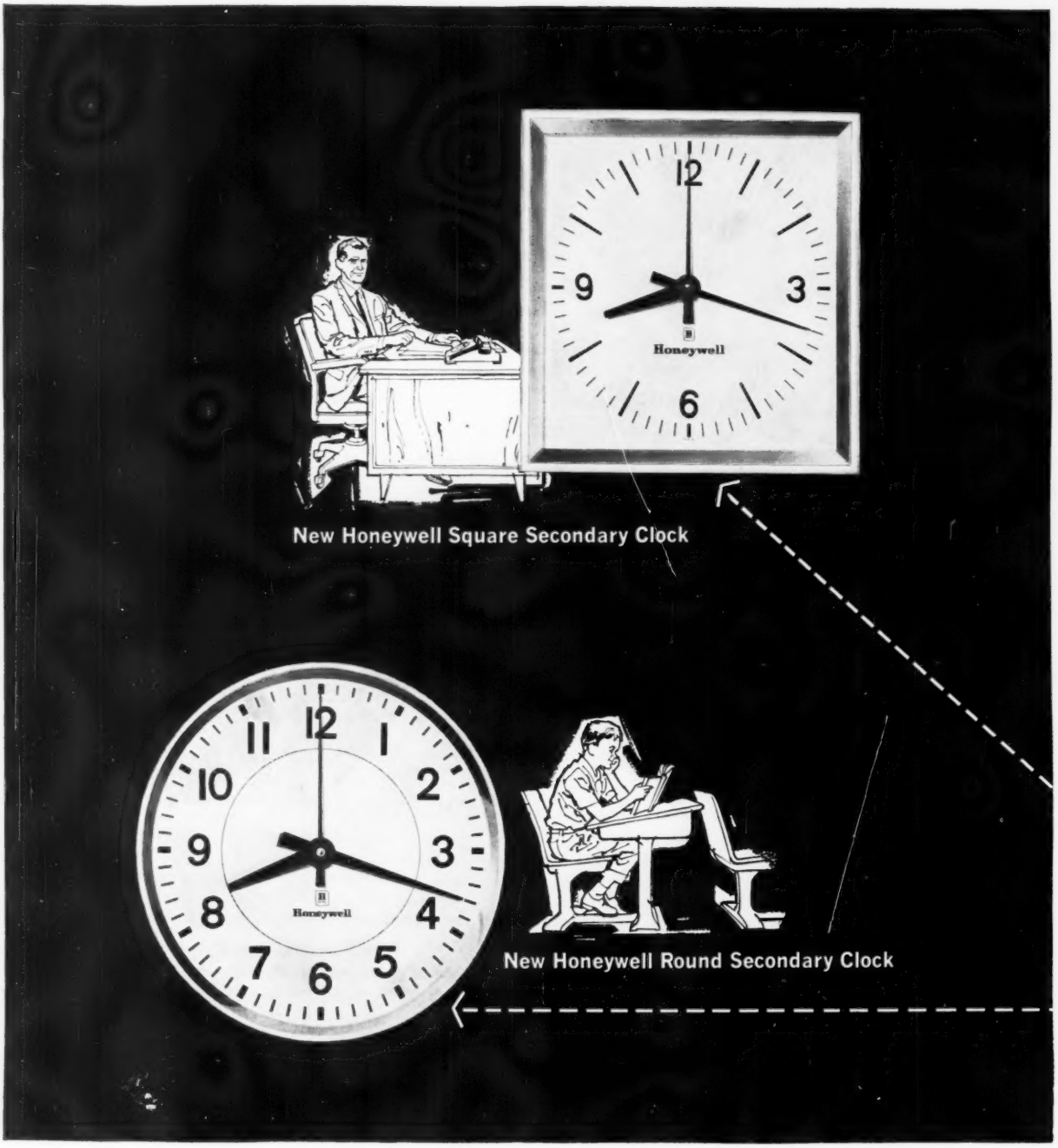
New Honeywell



ClockMaster* System!

New styling! New works! New reliability!

. . . Same simplified installation

and famous Honeywell follow-through

Henry Dreyfuss, noted designer, styled the appearance. Honeywell designed and manufactured the clocks. Result: a new standard of clock styling, accuracy and dependability—ready and waiting for your next job.

Now two standard secondary clocks

To complement modern styling, Honeywell has introduced a square, ultra-modern secondary clock. You can combine it with the new Honeywell round secondary clock in systems to better match decorating requirements. Both clocks have bold, clear numerals that are easy to read at a glance.

Life tests show no failures in over six years

Both the new square and round secondary clocks have new rocker arm assemblies plus vital parts made of teflon. This cuts friction and wear. Increases accuracy, reliability and life. So much so, in fact, that accelerated life tests have shown no failures in over six years—and the tests are still running!

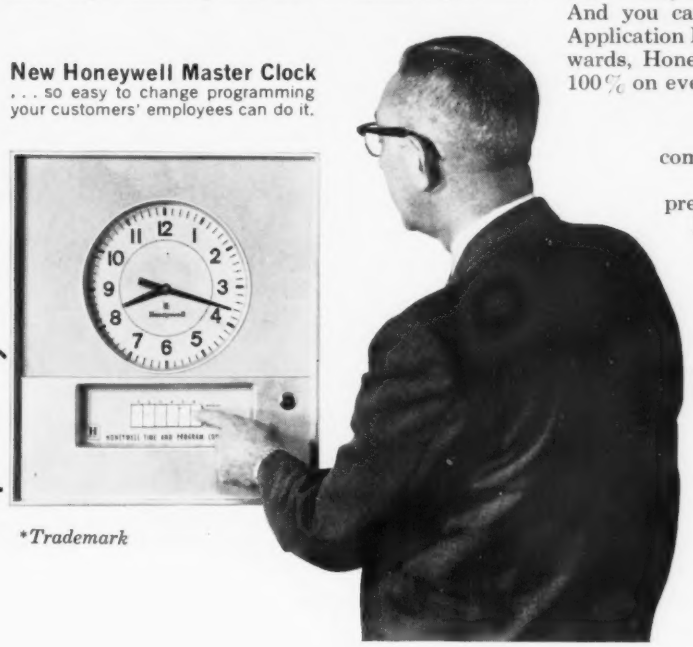
Foolproof system operation—even during power failures!

Programming of this newly styled master clock is so easy to change, one of your customer's employees can do it. Master time and programming units are positively linked so they can't get out of step. If power fails, the master clock switches automatically to a spring operation that runs it for 12 hours. Because each clock in the system is independently and automatically corrected hourly, all clocks are kept on time.

No installation headaches

Honeywell's unequaled service facilities assure prompt delivery exactly when you need it. Honeywell wiring diagrams are so accurate and easy to follow they're often called "best in the business." And you can always phone a nearby Honeywell Application Engineer if you should need help. Afterwards, Honeywell Maintenance men back you up 100% on every clock.

New Honeywell Master Clock
. . . so easy to change programming your customers' employees can do it.



Phone your nearest Honeywell office for complete information on Honeywell's new ClockMaster System. Or, if you prefer, write Honeywell, Dept. EC-8-164, Minneapolis 8, Minnesota. In Canada, write: Honeywell Controls, Limited, Toronto 17, Ontario.

Honeywell

First in Control

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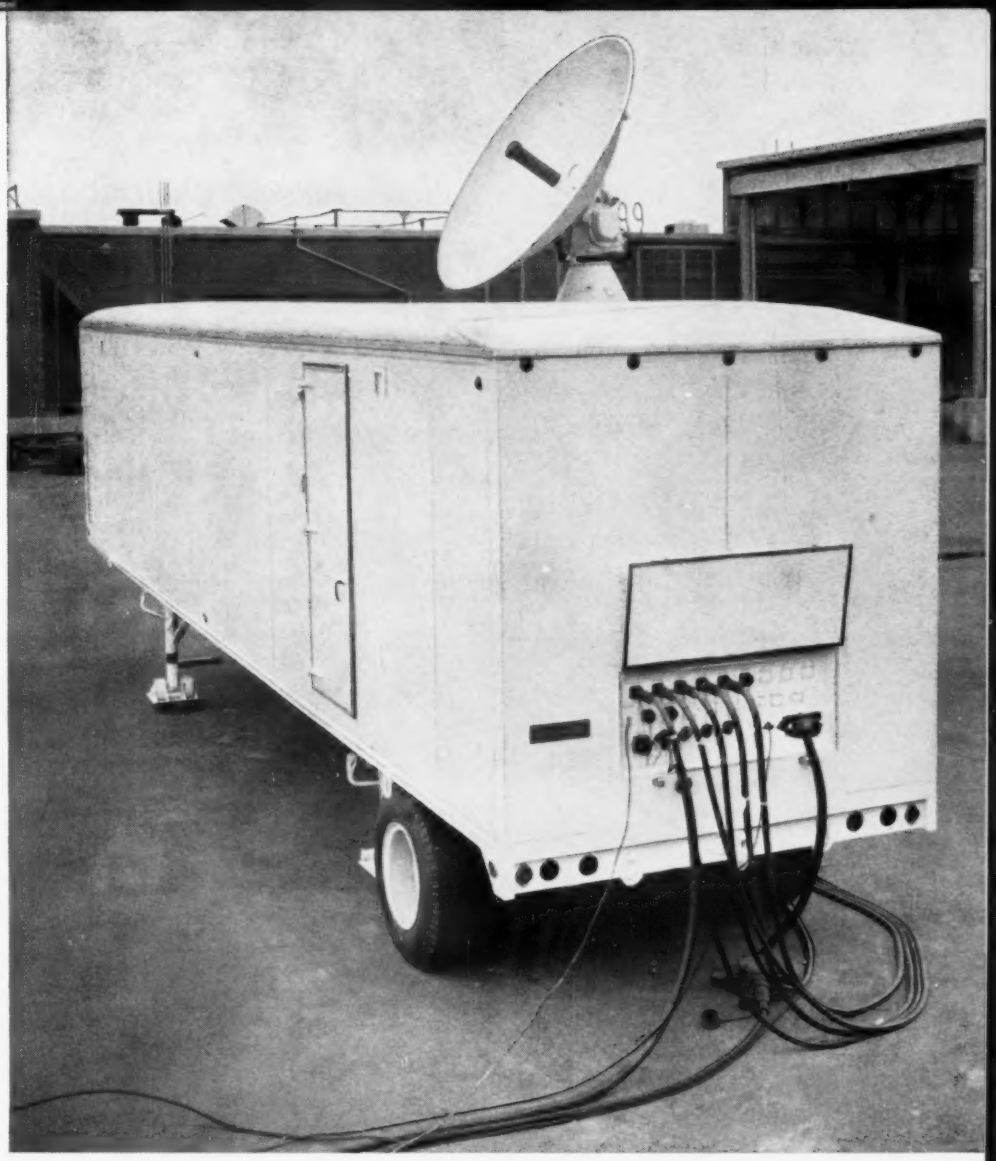
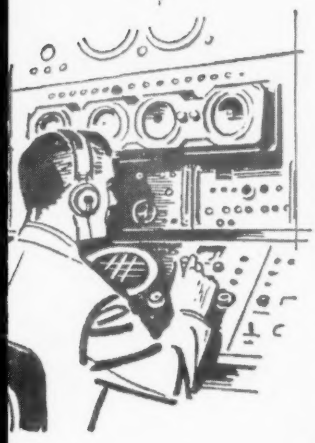


OKOCORD CABLES—

A vital link in keeping an eye on the man in space

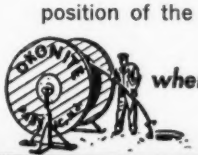


For Project Mercury's man in space assignment, radar keeps its electronic eye on the progress of the orbital flight and Okocord cables are playing a key role in this important function. Where dependability under all conditions is essential, it is more than likely you'll find an Okonite product is the **vital link.**

EXAMPLE: Tough, super-flexible Okocord cables serve as a power link between radar units housed in 35-foot trailers and separate radar antennas in equipment manufactured by the Reeves Instrument Corporation. A part of Project Mercury's Very Long Range Radar Tracking System, the unit shown here, is one of a number that will pinpoint the position of the first American to orbit the earth from blast-off to pickup.

Why were Okocord cables chosen for this vital assignment? Because power failure is out of the question and Okocord cables have earned their reputation for delivering under conditions ranging from normal to the abnormal. Like all Okonite cables, they're the result of Cable'bility—80 years of cable craftsmanship.

If you use portable cables for mobile equipment, apparatus, power tools and appliances, there is an Okocord cable designed for your specific needs. For full details . . . write for bulletin EC-1108—The Okonite Company, Subsidiary of Kennecott Copper Corporation, 220 Passaic Street, Passaic, New Jersey.



where there's electrical power . . . there's **OKONITE CABLE**

8238

Burlington, New Jersey, electrical contractor says:

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ELECTRICAL CONTRACTORS

Mr. Leonard P. Lettinger
Republic Steel Corporation
920 Suburban St...

June 13, 1960

...ing ELECTRUNITE,
...cutting and bending made easier, but wire-pulling
is also made easier by your Silverslick inside finish.

Very truly yours,

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Chief Engineer

Compatibility and strength characterize raceways made of Galvanized Steel

"Efficiency, time saving assured with REPUBLIC ELECTRUNITE E.M.T."

(ELECTRICAL METALLIC TUBING)

Burlington Electric Corporation installed thousands of feet of Republic ELECTRUNITE E.M.T. in a new Pitman, New Jersey, manufacturing plant.

Writes William V. Zemitis, Chief Engineer for Burlington, "I wish to comment on the wonderful success we have had on our jobs using ELECTRUNITE E.M.T.

"The men in the field have actually saved time with your "GUIDE-LINES" and "INCH-MARKS."

"As every contractor knows, efficiency and saving time in the field is of the essence; and as long as we keep using ELECTRUNITE, this is assured.

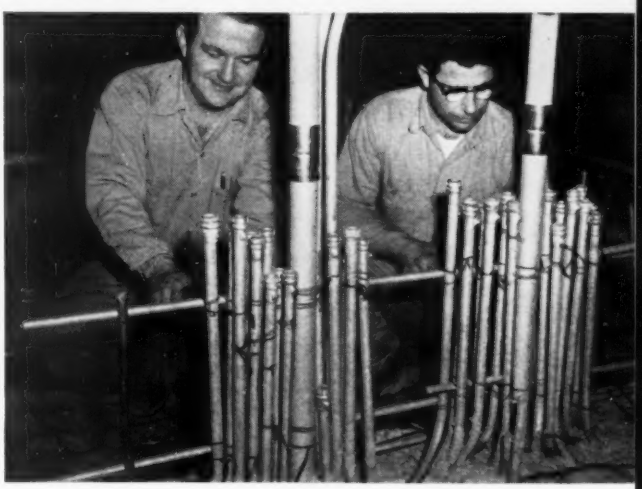
"Not only is cutting and bending made easier, but wire-pulling is also easier with your "SILVER-SLICK" inside finish."

Find out for yourself how the exclusive quality features of ELECTRUNITE E.M.T. can produce substantial savings in your electrical installations. Call your Republic representative or mail the coupon below.

NEW ONE-STORY manufacturing plant, Pitman, New Jersey. Architects: Minoru Yamaski & Associates, Birmingham, Michigan. Electrical Contractor: Burlington Electric Corporation, Burlington, New Jersey.

FULL-LENGTH "GUIDE-LINES"® AND "INCH-MARKS"® help make neater, more accurate installations. And "SILVERSLICK" interior surface makes wire-pulling up to 37% easier.

ELECTRUNITE E.M.T. in poured concrete in kitchen area of new plant. ELECTRUNITE is preferred for concrete installations because galvanized coating assures long-lasting, trouble-free service.



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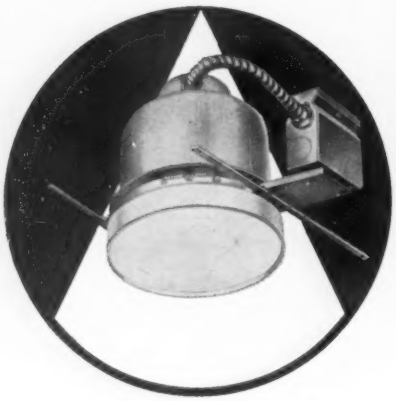

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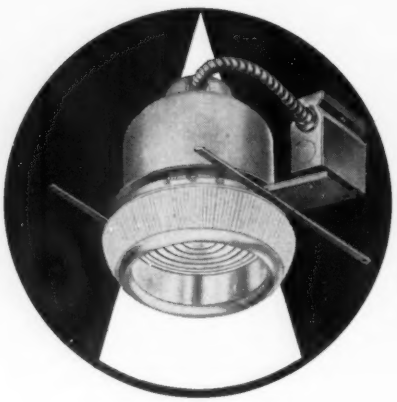

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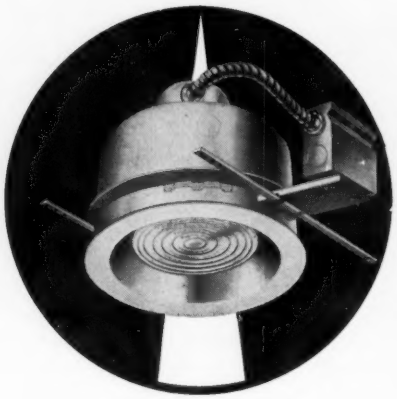

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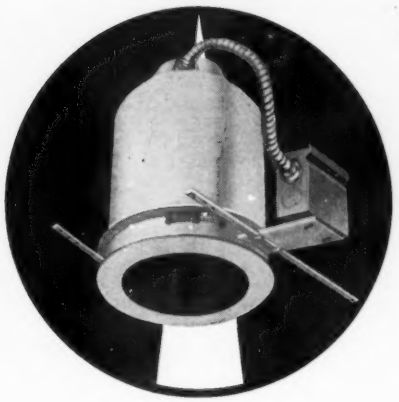

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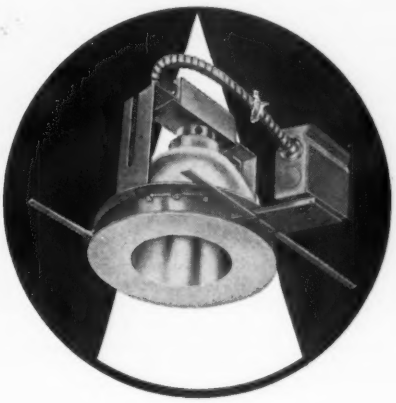

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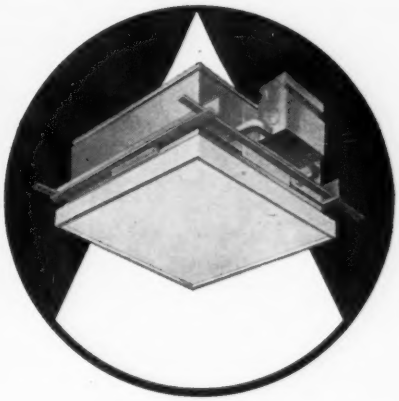

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Columbus: Elgee Elec. Co.
The Loeb Elec. Co.
Dayton: Duellman Elec. Co.
Springfield: The W. W. Elec. Co.
Toledo: Gross Elec. Fix. Co.
Youngstown: The Braff Ltg. Fix. Co.

OKLAHOMA
Oklahoma City: Elec. Sup. of Oklahoma
Hunzicker Bros.

OREGON
Portland: Baker-Barkon Co.
Malloy Robinson Co.

PENNSYLVANIA
Allentown: Coleman Elec. Co.
Erie: Kraus Elec. Co.
Harrisburg: Fluorescent Sup. Co.
Schaedler Bros.
Hazleton: Power Elec. Co. Inc.
New Castle: Midwestern Elec. Co.
Norristown: Norristown Elec. Sup. Co.
Philadelphia: Gold Seal Elec. Sup. Co.
Logan Elec. Sup. Co., Inc.
Pyramid Elec. Sup. Co., Inc.
Silver's Elec. Sup. Co.
Sylvan Elec. Fix. Co.
West Phila. Elec. Sup. Co.
Pittsburgh: Allied Elec. Sup. Co.
Argo Lite Studios
Brown & Green
Wally Elec. Sup. Co.
Reading: Coleman Elec. Co.
Scranton: Lewis & Reif, Inc.
Uniontown: Pioneer Electric Dist.
West Chester: West Chester Elec. Sup. Co.
Wilkes-Barre: Anthracite Elec.
Williamsport: Lowry Electric Co.

RHODE ISLAND
Pawtucket: Major Elec. Sup. Co.
Providence: Leavitt Colson Co.
Tops Elec. Sup. Co.

SOUTH CAROLINA
Columbia: Capitol Elec. Sup.
Noland Co.
Greenville: Sullivan Howe. Co.

SOUTH DAKOTA
Watertown: J. H. Larson Elec. Co.

TENNESSEE
Chattanooga: Mills & Lupton Sup. Co.
Memphis: Belvedere Lighting Co.
Nashville: Nashville Elec. Sup. Co.

TEXAS
Brownsville: Electric Fix. Sup. Co.
Dallas: Rogers Elec. Sup. Co.
Ft. Worth: Anderson Fixture Co.
Cummins Supply Co.
General Industrial Sup. Corp.
Houston: Anderson Lighting Co.
Gulf Coast Elec. Sup. Co. Inc.
Martin Associates
Worth Elec. Sup. Co.
San Antonio: Electrical Distrib. Co.
Southern Equip. Co.
Strauss-Frank Co.
Worth Elec. Sup. Co.
Waco: Dealers Elec. Sup. Co.

UTAH
Salt Lake City: Artistic Lighting

VIRGINIA
Arlington: Dominion Elec. Sup. Co. Inc.
Noland Co.
Lynchburg: Mid-State Elec. Sup. Co. Inc.
Roanoke: Noland Co.

WEST VIRGINIA
Charleston: Capitol Light Co.
Goldfarb Elec. Sup. Co.

WISCONSIN
Appleton: Moe Northern Co.
Eau Claire: W. H. Hobbs Sup. Co.
La Crosse: W. A. Roosevelt Co.
Milwaukee: Electri-Craft Lighting
Lappin Electric Co.
Standard Elec. Sup. Co.
Racine: Mitch Elec. Sup. Co.

WASHINGTON
Seattle: Seattle Lighting Fix. Co.

CANADA
Edmonton: Alberta Elec. Sup. Ltd.
Montreal: L. D. G. Products, Inc.
Gray Elec. Co.
Union Elec. Sup. Co. Ltd.
Toronto: Revere Elec. Dist.
Toronto Ltg. Studios
Union Elec. Sup.

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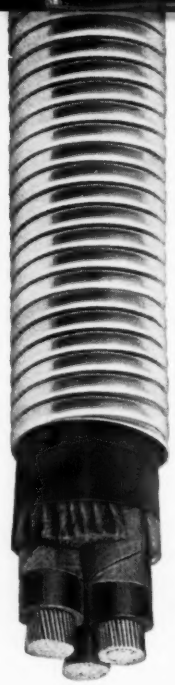

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

Identical Prices

Identical bids to government agencies on stock electrical products are under attack. The bidder is threatened with investigation. His legal and moral integrity is questioned. This might be dismissed as concerning few of the readers of this page, but the net effect could be to dry up vital price information essential to the orderly conduct of daily business in this electrical industry.

The problem arises from a conflict between government purchasing practice based upon sealed bids, preferably different, and industry practice of selling stock products on the basis of open price lists, broadcast to tens of thousands of customers, spelling out every detail of price and terms. Such "book" prices are usually identical to the last decimal for competing products as a result of normal competitive pressures in the open market. Even when "confidential" discounts are offered the effect is the same as suppliers quickly equalize their competitive positions.

Book price systems are an essential modern business control and communication mechanism. They convey exact price information through the sales organization. They establish discounts, terms and weighting factors for quantity, customer classification and other special consideration. They attempt to cover all probable sales negotiations involving catalogued products in a systematic and predictable pattern.

Since comprehensive and detailed price information is readily available to all concerned, the prices of competing products inexorably seek uniformity. No supplier can remain aloof because his customers will soon beat him into line if his price is high, and his competitors will quickly match his lead if his price is low. The forces of open competition thus compel prices to converge toward a standoff where they tend to stabilize.

There seems to be a belief current in government agencies that competition is expressed only by price differences. In much of our economy price differences play a minor and often negligible role. When prices are equal, as they very often are, all the vast resources of modern sales management come into play. Suppliers compete for customer preference with advertising and sales promotion, with skilled sales forces and tactics, with customer services, with product features and innovations. The forces driving prices to a standoff are only a small aspect of the total competitive battle.

It is to be hoped that out of the present discussion about identical bids a better understanding of the phenomena will come through. It is not at all clear what mechanism, of procedure or law, can be expected to encourage competitors to offer differing prices on stock products on which all price information is common knowledge. Until one is discovered, it is most unfair to cast suspicion on those who are exercising their best business judgment in compliance with the law. To suppress price information as a device to induce random differences would be capricious mischief.

Wm. T. Stuart

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This symbol stands for QUALITY

XL Bus Duct by BullDog

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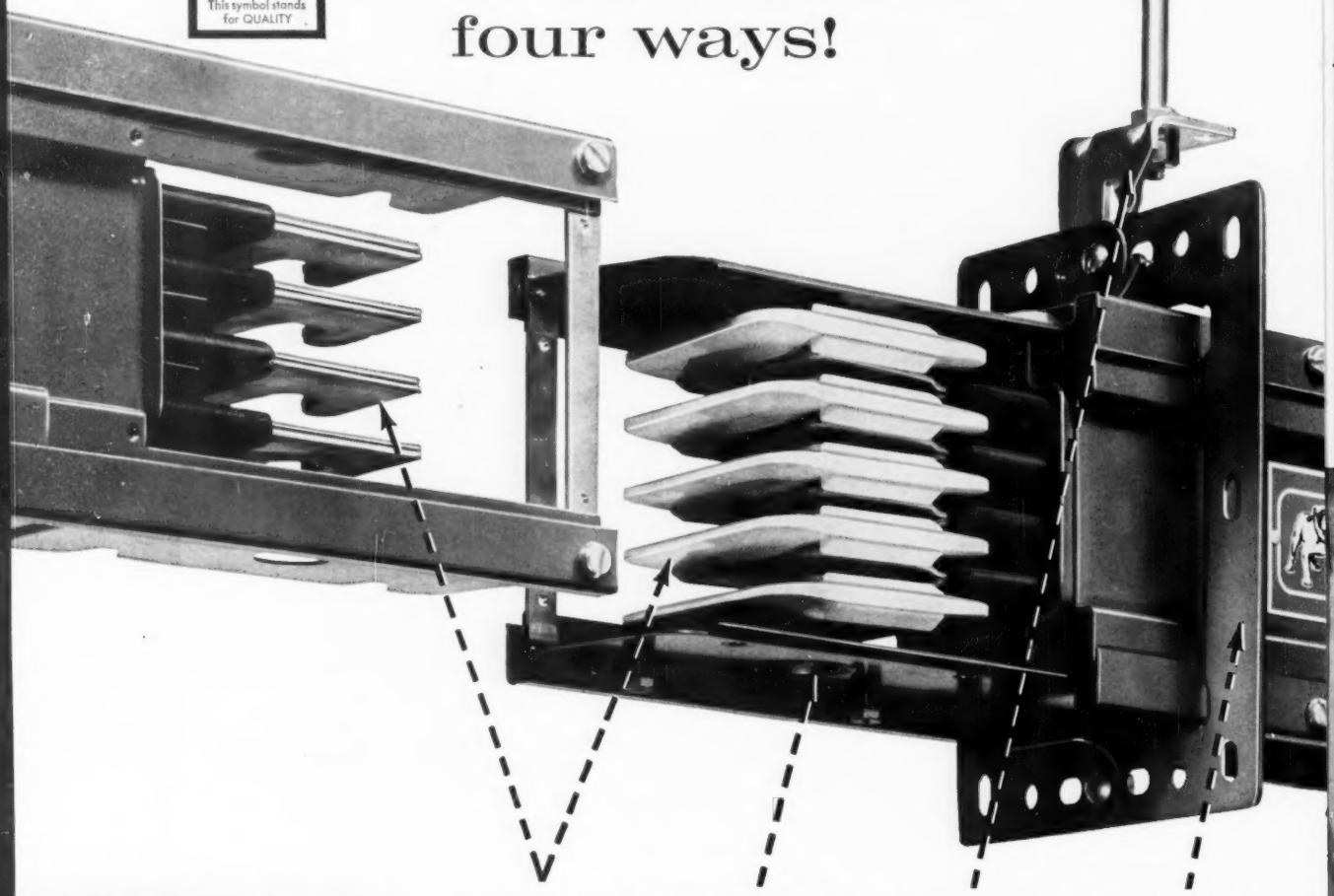
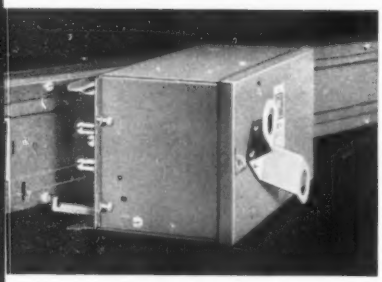


1 *Keyed ends* of plated aluminum bars align automatically, join as fast as sections can be handled.

2 *Single integral bolt* spins tight quickly to secure bars under a ton of pressure. Captive screws join casings together.

3 *New* HANGFAST *Adapter* bolts to suspension rod fast ...duct with standard hanger is instantly hooked and secured.

4 *Lightweight*, rigidly-made 10-foot sections require only *half* as many hangers as ordinary duct.



PLUG-IN SAFETY—Self-supporting XL Safety Plug hooks to duct, leaving workman's hands free to complete electrical plug-in with utmost ease and safety.

BullDog, the creator of plug-in bus duct, has for years assisted industrial plant operations by providing high performance, efficiency, flexibility and dependability in power distribution. Then BullDog went one step further . . . developed XL BUStribution® Duct to make installation and handling easier than ever before, as shown above. At the same time, BullDog incorporated foolproof dead-front safety as well as other features ensuring that workmen plug in for power the safe way *only!*

Ask your BullDog representative to show you all these XL Duct installation and safety advantages. He can also provide complete information about BullDog BD plug-in duct, LO-X® plug-in duct and LO-X feeder duct.

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I-T-E CIRCUIT BREAKER COMPANY

BULLDOG ELECTRIC PRODUCTS DIVISION

ELECTRICAL CONSTRUCTION AND MAINTENANCE

At Cape Canaveral . . .

Electrical Power Backup

Aids Missile Launching

Use of multiple sources of electric power on each launching complex provides power backup for uninterrupted testing and launching of a missile, once a "countdown" is under way.

By Berlon C. Cooper

ATLAS missile is shown during launch from Pad 12, Cape Canaveral. At left is umbilical tower, and at right beyond missile is the blockhouse. Note electrical cable (umbilical) at top right of tower, which has been blasted free from missile.

ELECTRIC power reliability is an absolute necessity and requirement in the launching of missiles and space rockets. At each and every stage of prelaunch testing and checkout, from the arrival of the "bird" at the pad to the final "3-2-1-ZERO" of the countdown, electric power must be continuously available, for a wide range of uses. During the countdown, electric power interruption cannot be permitted even for an instant. And following the launch, electric power is just as important—for the operation of cameras, radio transmitters and receivers, telemetry, instrumentation and communication.

It is from the Cape Canaveral Missile Test Annex that missiles and space vehicles are launched down the Atlantic Missile Range, part of the Air Force Missile Test Center operation at Patrick Air Force Base, Fla. Facilities at the Cape include launching areas with blockhouses, radio transmitter and receiver sites, telemetry receiver sites, radars, missile assembly buildings, guidance laboratories, liquid oxygen (LOX) plant, photo-theodolite and camera sites, power supply buildings, fire stations, and miscellaneous support facilities.

More than 30 separate launching facilities are located on the Cape's 15,000 acres. Facilities at the Cape are presently divided into three main missile-launching areas. One area is for Atlas and Titan ICBM launching pads; another includes launch pads and facilities for medium-range missiles, such as the Air Force's Thor and Jupiter, the Army's Redstone, and the Navy's Polaris; and the third has launch pads for cruise-type missiles—

Snark, Bomarc, Matador, and small experimental rockets. Launch facilities for other missiles—Minuteman, Centaur, Saturn—are under construction or have been completed recently.

Launching pads for cruise-type missiles and small experimental rockets are comparatively simple affairs. But launching facilities for flight testing of ballistic missiles are more complicated. The Atlas and Titan launching complexes are typical examples. For that reason, the electrical distribution systems and backup provisions for electrical power for typical Atlas and Titan launching complexes have been selected for discussion in this article, and to indicate the extent and complexity of electrical system design, construction and installation for missile launching facilities.

The Atlas is an Air Force surface-to-surface type ICBM, manufactured by Convair (Astronautics) Division of General Dynamics Corporation. The Titan is also an Air Force surface-to-surface type ICBM, produced by The Martin Company. Both Convair and Martin are prime missile contractors, with field stations at the AFMTC for missile flight testing. Also Convair and Martin each maintain and operate four complete missile launching complexes at the Cape.

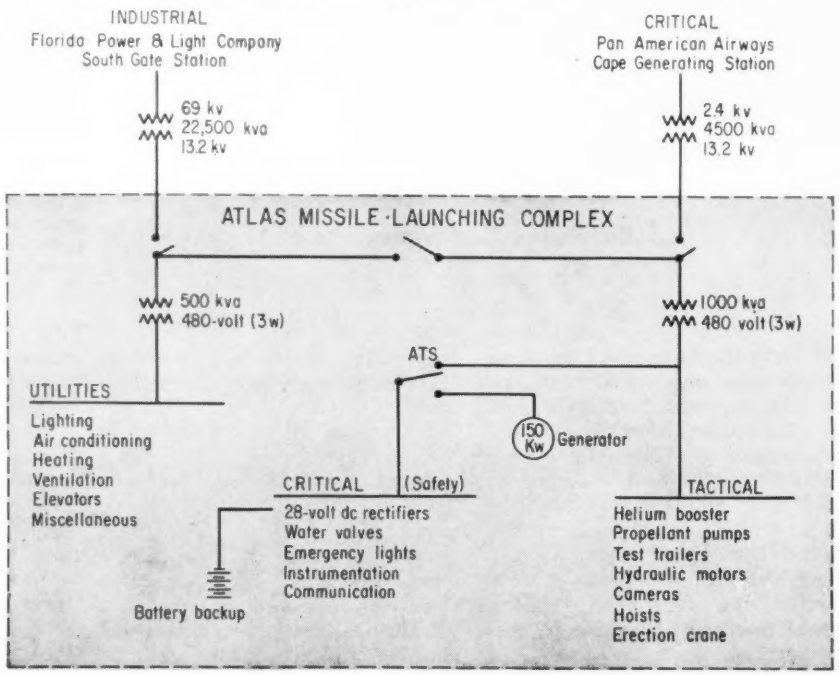
Electric Power Supply

Industrial electric power is supplied to Cape Canaveral by the local electric utility company at 69 kv, and transformed to 13.2 kv for distribution to substations at each launching complex, or other large facility. This is used as the primary source of electric power. However, critical electric power is available from a Cape generating station, installed and operated by Pan American Airways, which operates and manages the entire Atlantic Missile Range under contract with the Air Force Missile Test Center. This critical electric power is generated at 2.4 kv, and transformed to 13.2 kv for distribution to the substations at each launching complex. At the individual substations, the 13.2 kv power is further transformed to 480 volts for distribution and use at each complex. This is illustrated in the single-line diagram which shows the electric power supply for a typical Atlas launching complex, and in a similar diagram which shows electrical circuitry for a typical Titan launching complex. The 480-volt power at both Atlas and Titan complexes is further transformed to 120 volts for miscellaneous utility uses, to 28-volt dc power for controls, and to 400-cycle 208Y/120-volt power for tactical uses. Rectifiers are used to convert the 480-volt power to 28-volt dc power, and electric storage batteries are used as a backup for the 28-volt dc supply. The single-line wiring diagrams illustrate these conversions to utilization voltages and frequencies, and the feature of electrical backup used to insure continuity of electric power at all times.

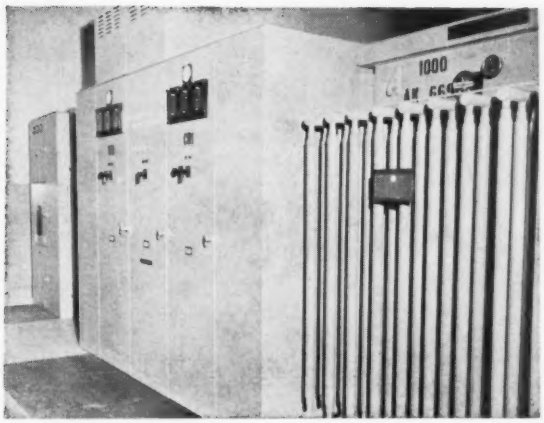
Typical Launch Complex

An explanation of the building structures and supporting facilities which comprise a missile launch complex will facilitate the visualization of the amount of electrical construction work and electrical wiring required to make the launching complex operational. Typically,

Electric Power Supply for Typical Atlas Launching Complex



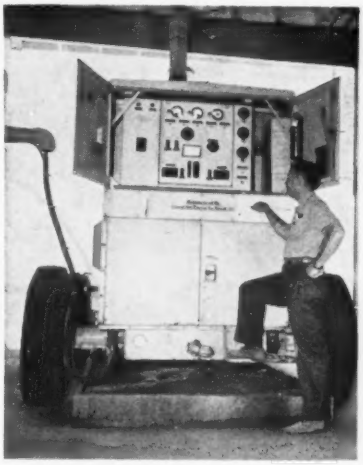
CONTINUITY of electric service during pretest and final "countdown", preceding a missile launching, is assured through multiple sources of power supply as indicated in the above diagrammatic power-distribution diagram for a typical Convair launching complex.



MAIN SUBSTATION converts 13.2-kv power to 480-volt utilization voltage. 1000-kva transformer is at right. Center panel contains switch for hookup to "industrial" or "critical" supply, as desired or necessary.

SWITCHGEAR bank for 480-volt power distribution. This is typical standard equipment, and is used to supply power for standard utilities, as well as for critical and tactical power, control circuitry and instrumentation.

MAIN DISTRIBUTION board for 480-volt buses.



EMERGENCY GENERATOR is diesel-operated, supplies 150 kw at 480 volts as backup for the critical safing circuits.

RECTIFIERS operating on 480-volt system convert power to 28 volts dc, for control and ground supply systems.

a launch complex includes a blockhouse area and ready room, separated from a ramp and test stand area by about 750 ft. The blockhouse and test stand (or launching pad) are supported by a fuel storage area, water main, drainage canal, parking area for service tower, and camera road and pads.

Launching facilities for ICBMs include an umbilical tower and a service tower, or gantry, nearly eleven stories high. Service towers are usually mounted on rails, so that they may be positioned over the launch pads for servicing operations, or moved away to permit firing. Platforms at various levels enable crews to perform final checkout and servicing operations.

In the newer Titan launch pads, the service towers work on the erector principle. They are raised for prelaunch servicing operations and then lowered for the launch.

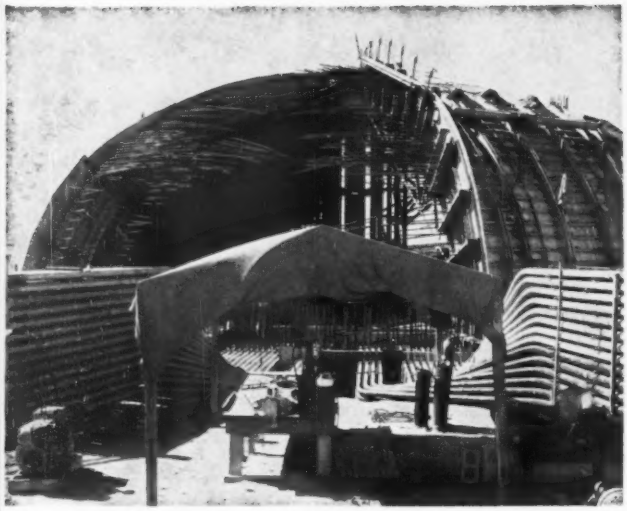
Supporting facilities, along with the service tower, provide a work tower, fuel, compressed gases, electrical power and coolant water.

The blockhouse is a steel-reinforced concrete building in which action is taken to launch the missiles. It is designed to withstand an explosion equivalent to 50,000 pounds of TNT at a distance of 50 ft. During a flight test, the blockhouse is occupied by personnel of the missile contractor for the missile being launched—Convair for the Atlas, Martin for the Titan, etc.

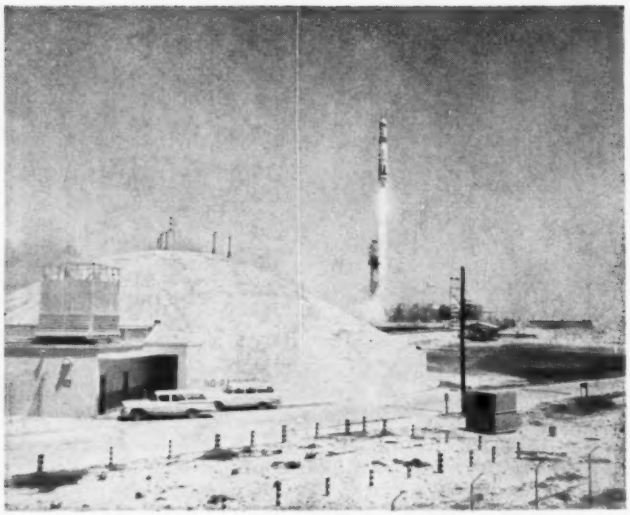
The Countdown

Electric power and electric instrumentation is at the very heart of the testing of complex missiles. It permits exhaustive minute-by-minute data on each firing. Scores of valves and electrical connections and instruments, tanks, lines and hoses are checked, one by one. Then, when the critical individual parts have been okayed, the testing turns to subsystems, then to entire systems. This is done from the blockhouse, by a "test conductor" and a group of panel operators.

As the testing proceeds, the huge service tower that surrounds the missile is rolled back, or lowered if of the erector type, to its transfer table, then rolled on railroad tracks

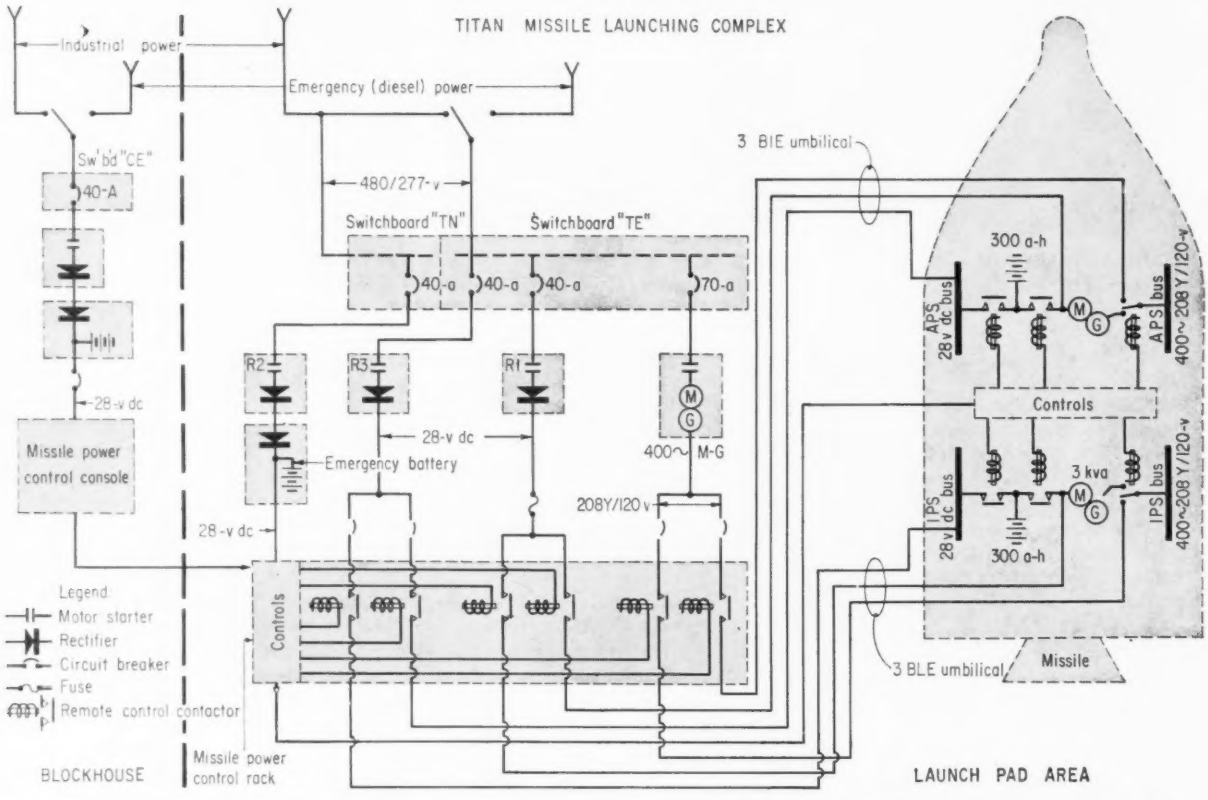


TWO BANKS of conduit extend from the blockhouse to the launching pad at each launching complex, as shown in this view made during construction. Distance from blockhouse to pad is usually about 750 ft. Conduit runs and other services are later enclosed in concrete, to form a surface "tunnel" for protection.



TITAN missile is shown being launched from Pad 16, with blockhouse in left foreground. Surface "tunnel" which connects blockhouse and pad can be seen over blockhouse at right. The tunnel houses the mass quantities of control and instrumentation wiring, which connects the blockhouse consoles with the missiles and launch pad electrical equipment.

Electrical Circuitry for Typical Titan Launching Complex



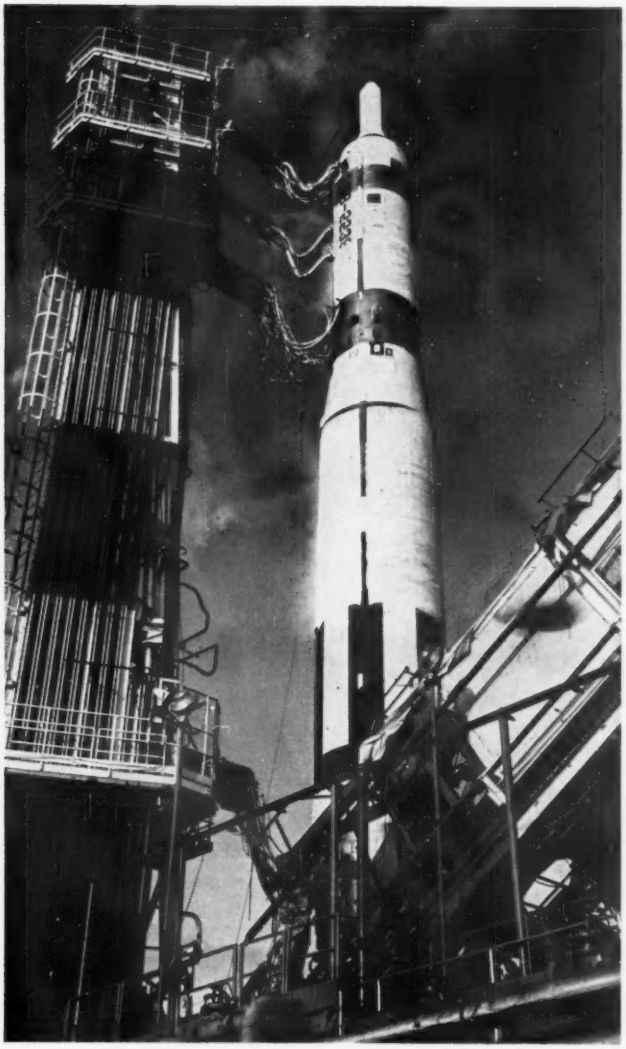
FLOW of electric power from industrial or emergency power supply buses to missile is shown by this single-line schematic wiring diagram. Basic power supply to blockhouse and launching pad switchboards is 480/277-volt, 3-phase, 4-wire. Rectifiers and M-G sets convert this power to 28-volt dc for controls, and to 400-cycle 208Y/120 volts for power uses. Emergency batteries are used for 28-volt dc backup as indicated.

to an area about 800 ft from the missile, and the area around the launching pad is cleared of personnel. From this point on to final liftoff, the missile is fueled and all further checks are made entirely by remote control from the blockhouse. At two minutes before firing, all missile electrical circuits are switched to internal power sources. As the countdown continues, checking of every item continues—missile power, AMR telemetry, propulsion, water flow to full, "range ready" light on, pressurization, fuel tanking, etc. When every panel light is on, indicating each major system is ready to go, the test conductor pushes a button on his console, his last act necessary for launching the missile. For the next 18 seconds an automatic sequencer does all the work. Only if something goes wrong during this period will there be human action now—action to stop the test.

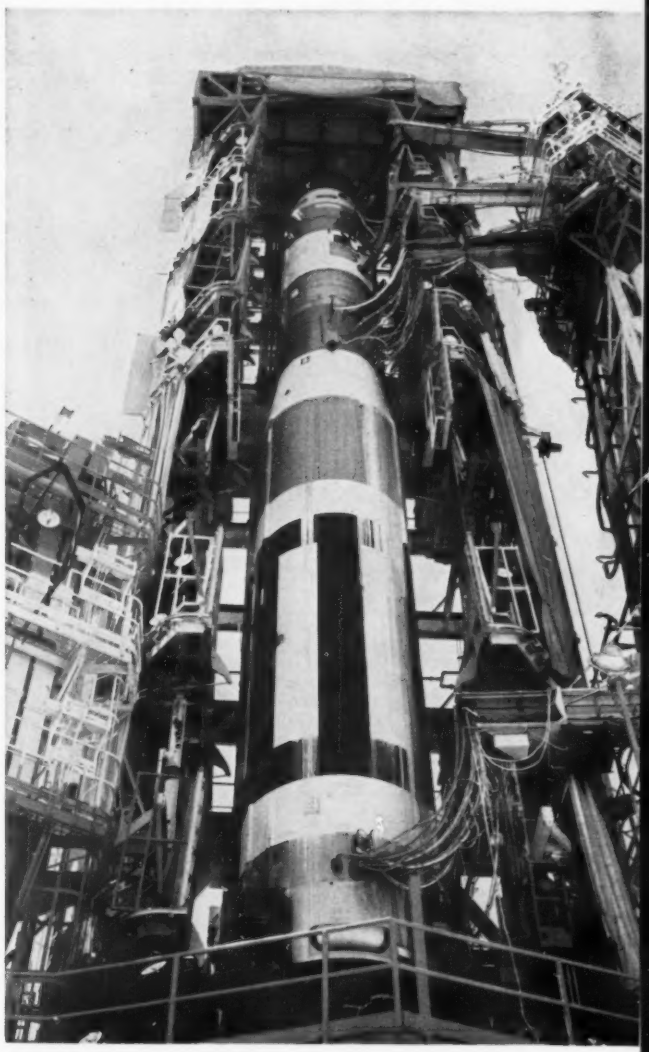
During the last 15 seconds, waterflow over the flame bucket reaches its full force of 35,000 gallons per minute, automatic cameras begin operating, small vernier engines on the side of the missile are ignited, rocket engines roar to life belching great streams of flame, arms holding the missile on the launching pad fly back, and the "liftoff" begins! The missile goes straight up, its tail of flame beating down on the launching pad, and it begins to accelerate rapidly.

Controls and Instrumentation

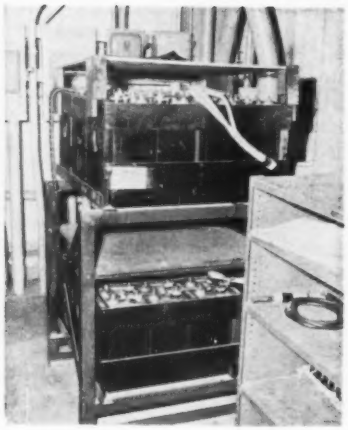
Electric power and complicated electrical circuitry has played a mighty part in this missile launching. Some idea of the amount of electrical work involved on a typical launching complex can be had from the following list of material used on each complex: 650 multiconductor cables ranging from 5 ft to 1200 ft in length; 5,000 ft of



ERECTOR TOWER is removed from missile by swinging the top back while the base remains fixed in place. Note umbilical cables connected to free-standing missile, ready for instrumentation and checking during final countdown.

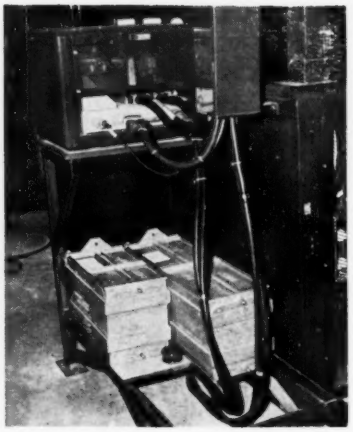


ERECTOR TOWER surrounds static Titan missile on Pad 19 during preliminary testing and preparation for launching. Note maze of cables between umbilical tower (right) and missile.

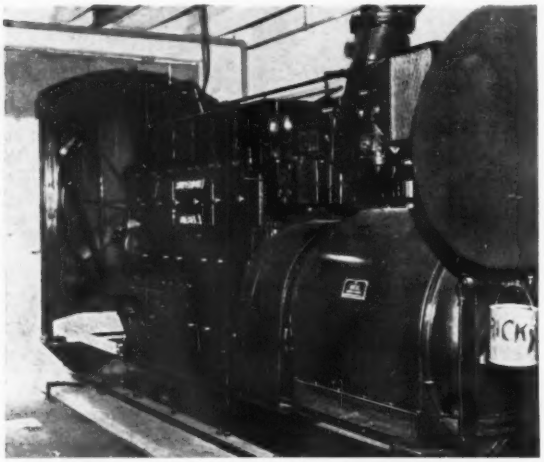


BACKUP for rectifiers is a bank of nickel-cadmium batteries, supplying 28 volts dc. Switchover from rectifiers to batteries is automatic, in case of rectifier outage.

SWITCHOVER from industrial to emergency power is accomplished by this automatic transfer switch.

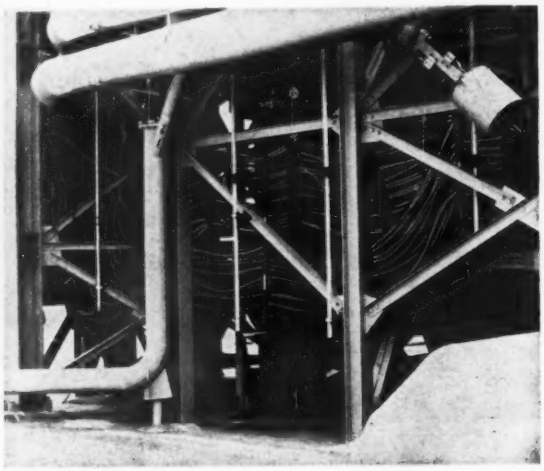


RECTIFIERS and emergency battery located in upper equipment room, beneath the Titan launch stand, provide 28 volts dc and power backup to control rack.

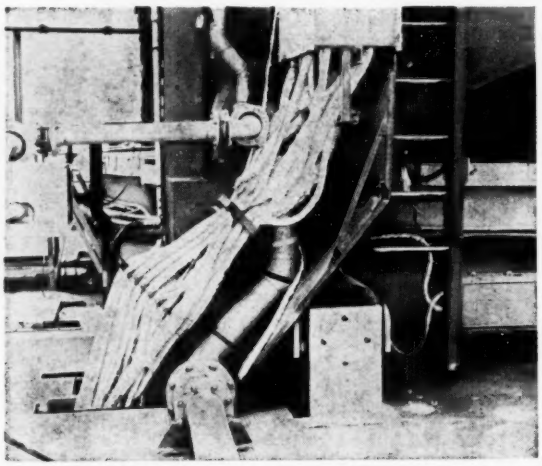


EMERGENCY POWER at 480/277 volts is supplied by a diesel-operated generator, installed in Titan blockhouse.

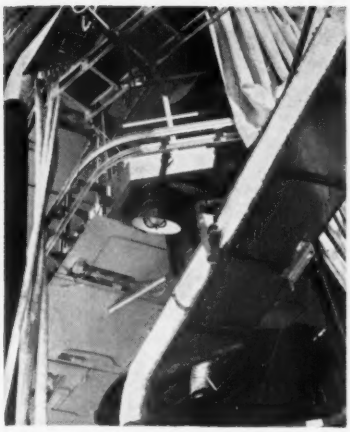
POWER for emergency lighting is supplied by a battery backup, located in blockhouse, and supplying 120 volts dc.

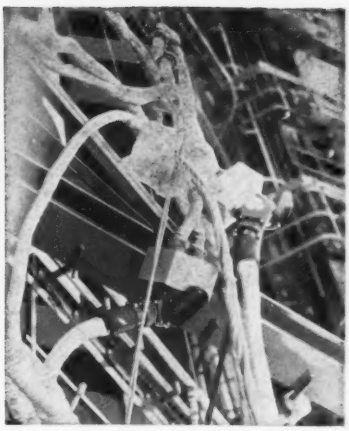


MAZE OF CABLES shown here are located beneath the Titan launch stand, and feed up the umbilical tower.



POWER CABLES at base of erector tower supply power to erector motors and to other equipment.





UMBILICAL CABLES shown here are located at sixth and seventh levels of umbilical tower, viewed from erector tower. These cables supply both 400-cycle and 28-volt dc power to the missile during preliminary testing and checking, and provide for control and instrumentation up to the point of final launching.

waveguide; 20,000 ft of coaxial cable; 18,000 soldered connections; 40,000 lugged terminations; 50 miles end-to-end cable; and 1,000 miles end-to-end wire.

In general, the electrical work required for motors, lighting, air conditioning, ventilation, elevators, and other miscellaneous utilities, in the blockhouse and ready-room building is conventional. Also, the wiring of motors, lighting, etc. at the launching pad follow standard electrical system design. The big wiring job is for controls and instrumentation. Power for conventional utility uses is at conventional voltages — 480 volts for large motors, 120 volts for small power requirements and lighting. Basic system for controls and instrumentation is 28 volts, same as the missile power source voltage. In the typical blockhouse there is a total of 40 consoles, each designed to control a separate function of the launching, and to provide complete instrumentation for that function. For example, propellants are handled 100% remotely. When a missile is fueled, there are literally hundreds of valves that must be controlled, all from the blockhouse control console.

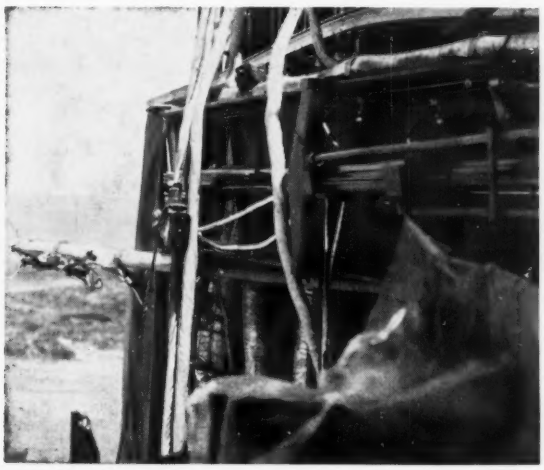
On the test stand, all wiring and lighting is of the explosion-proof, hazardous-area type.

Umbilical cables are used to provide electrical power to the missile and to maintain controls and instrumentation from the beginning of a countdown until all circuits are switched to internal power sources, two minutes before the point of launching. A dozen umbilical cables are used, with up to 140 wires in each cable. These cables, attached to the missile by huge connectors, are blown free from the missile by a nitrogen blast just before liftoff.

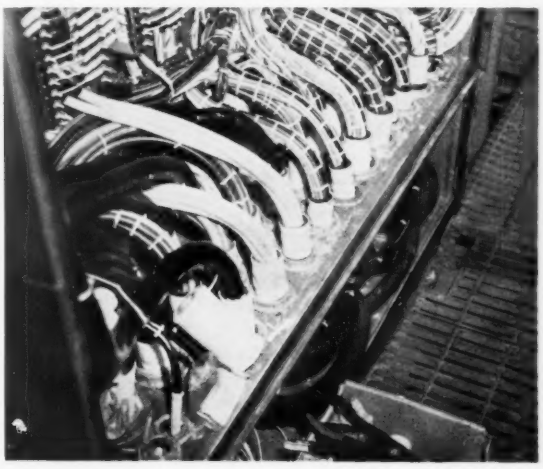
Umbilical cables on the umbilical tower are subjected to tremendous fire hazard as the missile eases up from the pad, with temperatures up to 5000°F. Experience has indicated that by wrapping the cables in asbestos tape, up to 75% of the cables can be saved. If part of a cable is destroyed by this heat, the entire cable has to be pulled out and replaced.

Knowledge gained at Cape Canaveral Missile Test Annex extends to electrical power requirements and electrical systems design for missile launching at operational bases. Electrical plans and specifications are prepared by the Corps of Engineers, in cooperation with individual missile contractors at Cape Canaveral, such as Convair and the Martin Company. This knowledge and experience, in turn, has been put to use in the design of the electrical systems for the approximately 330 silos which are now in an advanced stage of construction at operational missile bases located throughout the country.

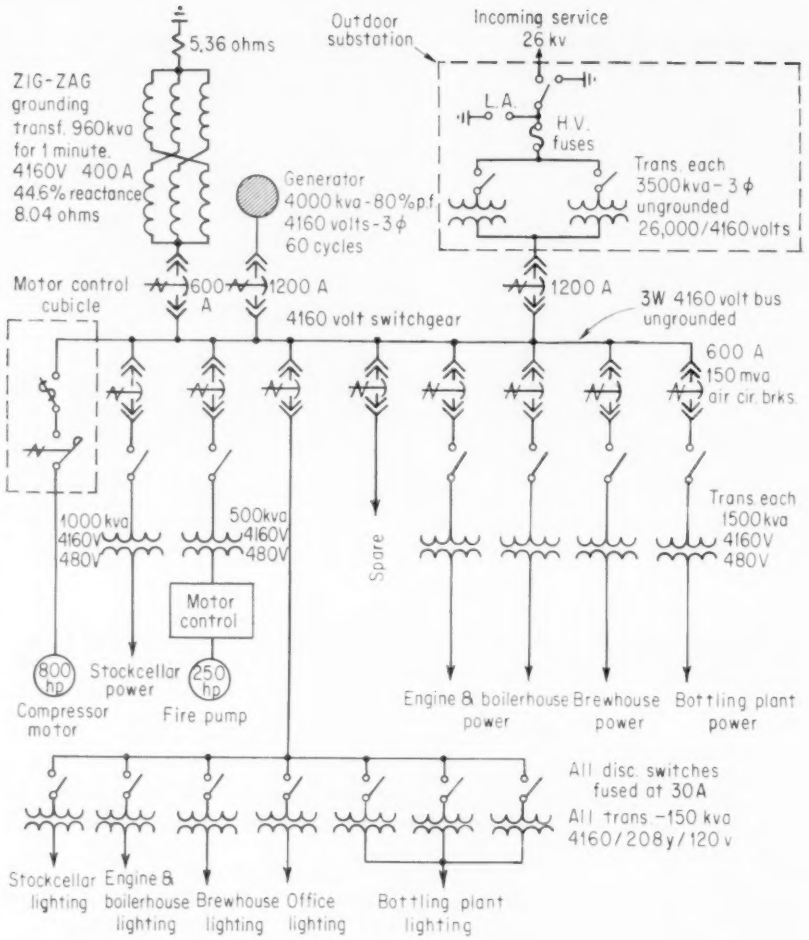
The information on which this article is based, including drawings and photographs, were supplied by Convair and Martin engineers, and by the U. S. Air Force.



POWER CABLES at fourth level of umbilical tower plug into missile for power requirements.



JUNCTION BOX located at fourth level of umbilical tower reveals the maze of wires and cables required.



ONE-LINE DIAGRAM shows how primary power at 4160 volts feeds five unit substations, 800-hp synchronous motor, fire pump transformer and lighting transformers. Separate primary lighting circuit provides increased lighting reliability since equipment feeder faults will not affect the lighting feeder. Zigzag grounding transformer establishes neutral ground on the 4160-volt, 3-wire primary system.

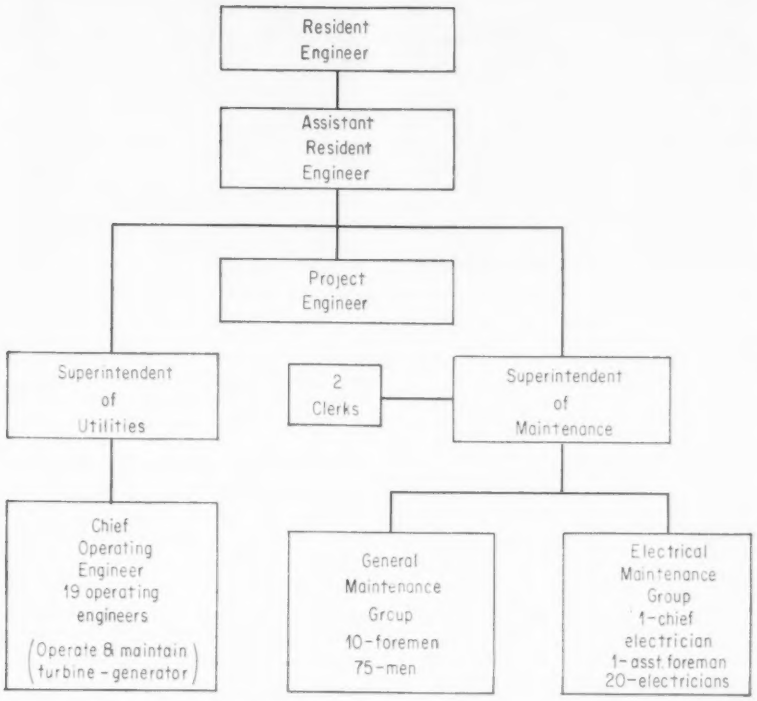
Electrical Maintenance By Contract

By Robert J. Lawrie

Third in a series of articles on current industrial electrical maintenance. Previous studies were: (1) Effective Large Plant Maintenance, April 1961 and (2) Effective Small Plant Maintenance, June 1961. The series covers operating procedures and work methods in typical industrial plants revealed through personal interviews with key plant personnel.

IN MANY instances industrial plants have realized that, like a good electrical preventive maintenance program, contract electrical maintenance will eventually pay off. Advantages gained include expert service resulting in less downtime, flexibility in size of work force, and a reduction in union and labor problems. And, at the Anheuser-Busch brewery in Newark, N. J., these advantages are evident in a notable application of electrical maintenance by contract.

Employing nearly 1000 workers, this multi-building brewery produces 1,800,000 barrels of Budweiser beer annually. Major process equipment includes highly automated conveyor systems; giant compressors powered by 4160-volt, 800-hp synchronous motors; various pumps driven by induction motors which range up to 200 hp;



MAINTENANCE ORGANIZATION at the Anheuser-Busch brewery is headed by the resident engineer, who keeps a broad control over the system. The assistant resident engineer and the project engineer design new installations and assist in cost control. Under the superintendent of utilities, a chief engineer and 19 operating engineers operate and maintain the 4000-kva turbine generator. The superintendent of maintenance supervises a general maintenance group, who perform non-electrical maintenance; an electrical maintenance group; and 2 clerks who handle paper work. Working on contract, the electrical maintenance group consists of a chief electrician, who directs an assistant foreman and 20 fully qualified electricians.

Many industries are finding out that bringing in outside contractors is the most effective and, in the long run, the most economical way to accomplish electrical maintenance. At the Anheuser-Busch brewery, Newark, N. J., 20 electricians, working on contract, provide expert maintenance for modern and highly advanced equipment.

and other types of associated process apparatus.

To power this equipment, a 4000-kva steam-turbine generator provides 4160 volts in a primary network to major buildings. An outdoor substation, equipped with two 3500-kva, oil-filled transformers, supplies additional power at 4160 volts. Fed at 26 kv, the substation transformers can be energized separately or in parallel.

Many areas require special protective equipment. Because of the presence of grain dust in certain areas, much of the installed equipment is dust-ignition proof. And because of the extensive use of water, practically all other areas require watertight equipment.

The following personal interview with Robert R. Hahn, the assistant resident engineer, and Leo Knoller, chief electrician, reveals the "hows" and "whys" of the firm's electrical maintenance program and detailed information on the electrical maintenance procedures.

How is your maintenance department organized?

We have a central maintenance organization headed by the resident engineer. He keeps a broad control over the entire system and has the final authority pertaining to maintenance department policies. Directly under him are the assistant resident engineer and the project engineer, who are responsible for new equipment selection and installation design and also assist in cost control. Next are the superintendent of utilities, who is responsible for the operation and maintenance of the 4000-kva steam-turbine generator, and the superintendent of maintenance, who is responsible for maintenance of process equipment and buildings.

Under the superintendent of utilities, a chief operating engineer directs a crew of operating engineers, who operate and maintain the turbine generator. The superintendent of maintenance supervises the general maintenance group (who perform all non-electrical work) and the electrical maintenance group. Headed by a chief electrician, the electrical maintenance group consists of one assistant foreman and 20 outside electricians on contract. In addition, the maintenance department employs two clerks to handle job orders, requisitions and preventive maintenance records.

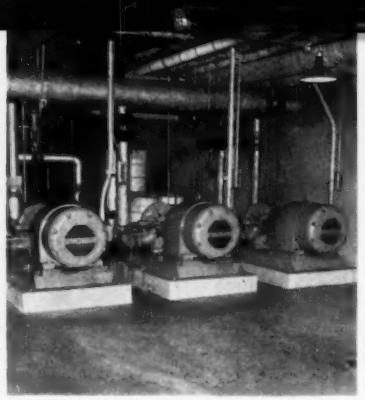
What factors lead to your decision to set up a separate electrical maintenance force of 20 outside electricians on contract?

The most important factor is that it is an established Anheuser-Busch policy that only the best in men, material and methods be employed. We believe that striving for the best in every possible manner will result in a better product for our consumers. Therefore, after the maintenance department had justified the need for expert electrical maintenance, it was decided that electrical maintenance should be performed by a separate group made up of qualified electricians. We feel that trained electricians are best qualified to do the job.

In addition, we have much specialized equipment which justifies the need for expert electrical main-

AT THE MOTOR REPAIR BENCH electricians troubleshoot motors, make repairs and functional tests. Experienced in motor repair, these electricians can analyze trouble and make repairs rapidly. At top left corner of photo is a combination ground detector-fault locater.

RELAY PANEL receives thorough inspection every three weeks. Each contact on every relay is checked and its condition recorded on sheets that list each relay. These sheets not only provide checklists for the inspector but also indicate repetitive trouble spots.



INDUCTION MOTORS, each rated 30-hp 480 volts, drive centrifugal pumps. Every three weeks, electricians clean motors, check for overtemperature and any unusual conditions. After the inspection, condition of each motor is recorded in a special card file.

tenance. In grain elevators and in other process areas where grain dust is a hazard, there are many installations of dust-ignition proof equipment. Also, practically all areas are subject to large amounts of water and high humidity. This presents additional problems and hazards to an electrical maintenance man. And, besides the heavy processing equipment, we have several completely automated, high-production conveyor systems, which require extensive electrical preventive maintenance.

Don't you find that employing 20 electricians is an expensive luxury?

No, not under our present program. We have an agreement with a local contractor to supply us with as many men as we may need. Usually, we have about 20 men to handle the normal work load. The number of men required has varied from time to time; however, the nucleus of the crew has been with us since we started operations.

We think we're getting our money's worth because: (1) we get top-notch service from experts who, over the period of years, have become familiar with our electrical design, installation and maintenance problems; (2) we can reduce or increase the size of the work force easily; (3) union and labor relations problems are reduced; (4) the contractor has done all of our major electrical construction; (5) this system has been in use here for many years and although you might say contract maintenance is still on trial, we have not seen any reason to change.

What kind of power distribution and equipment do you have?

A 4000-kva, steam-turbine generator supplies 4160 volts for primary distribution to major buildings. For additional or auxiliary power, the utility company brings 26 kv to our outdoor substation. Here, two 3500-kva, oil-filled transformers step down this high voltage to 4160 volts for primary distribution. Both power supplies, connected in parallel, feed metalclad 4160-volt switchgear, which is located in the engine and boilerhouse nearby. From here, feeders extend via drawout air circuit breakers to unit substations, which are located in major buildings. Each substation supplies 480 volts, 3-phase, ungrounded, through fused switches or air circuit breakers to the various loads.

Lighting circuits are kept separate from power circuits. From the 4160-volt switchgear, lighting feeders extend to seven 150-kva transformers which are strategically located in major buildings. These transformers provide 208Y/120 volts for incandescent and fluorescent lighting.

Fault-locating equipment and ground detectors assist us in finding a ground fault which may occur on our ungrounded 480-volt distribution system. On the 4160-volt, delta-connected primary system, a grounding transformer establishes a neutral ground, which provides us with the advantages of a grounded system.

How is system grounding, through this grounding transformer, an advantage to you?

Grounded electrical systems are easier to maintain than ungrounded systems. Disadvantages of ungrounded systems include: (1) Ground faults are more difficult to locate. (2) During ground fault conditions, over-voltages appear on other phases which may cause a second fault before the first is removed. If this happens, locating these faults is extremely difficult. (3) In addition, a small current ranging from a few amperes to possibly 30 amps will flow through the capacitance of cables, transformers, etc., during fault conditions. If this current is not removed it may, in time, cause considerable damage.

The zigzag grounding transformer with the series resistance eliminates these problems. Advantages gained include: (1) immediate knowledge of a ground fault and its general location is indicated because the appropriate circuit breaker will trip; (2) over-voltages due to faults cannot occur, which eliminates over-voltage stress on insulation and results in longer insulation life; (3) because this type of grounding reduces short-circuit current, less damage occurs due to the burning and melting effects of a high fault current.

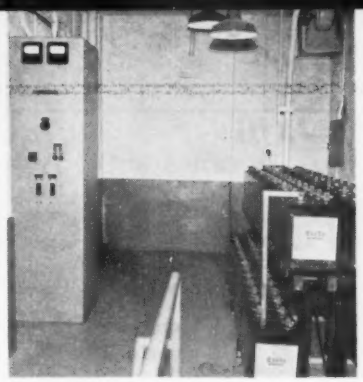
Do you have an electrical preventive maintenance (EPM) program?

Yes. Routine inspections are carried out during the day. More detailed inspection and repairs are accomplished on night shifts or week ends. We maintain a close control over the electrical PM. All electrical equipment is listed in a card file and we have a scheduled PM for all apparatus. From these and from the daily log book, we can schedule the day's EPM inspection and other work. Every three weeks, we make a thorough visual inspection of all electrical controls, motors and process equipment.

What kind of records do you keep?

When an EPM inspection is com-

MINIATURE PHOTO-ELECTRIC EYE counts bottles of beer as they pass on conveyor (see arrows). If a bottle tips over, conveyor will automatically stop. When testing the photo-electric eye and related components, electricians take voltage and resistance readings.



STORAGE BATTERIES provide auxiliary 125 volts for 4160-volt circuit breakers. At proper intervals, charging panel will automatically supply charging current (½ amp at 129 volts). Electricians take voltage, hydrometer and temperature readings weekly.

plete, the electrician will note the results in the daily log book. We then mark the inspection complete in the equipment card file or, if repairs are needed, we will schedule a thorough examination of the equipment.

In our bottling plant, miles of automatic motorized conveyors plus other automated equipment require hundreds of relays, limit switches and other controls. We have very little trouble with this equipment because of intensive electrical PM. Every three to four weeks, each contact on every relay and switch is checked and its condition recorded on special graph-paper sheets. There is a separate sheet for each conveyor system with each relay or switch listed across the top. Down the side, the inspecting electrician will sign his name. During the inspection, he will mark the condition of each relay in the proper square. This not only provides a check list for the inspector, but also will indicate repetitive trouble spots.

We have a card file which lists all electrical equipment including motor information, EPM inspection results and other pertinent information.

What EPM do you perform on the outdoor substation?

Once a month two electricians make a visual inspection looking for cracked bushings, oil leaks, and any accumulation of dirt. If an urgent discrepancy appears, we'll deenergize the station for repairs. Each year before winter, a crew of electricians make a thorough inspection of the station. They will tighten all connections, thoroughly clean all equipment and take oil samples from the transformers. These oil samples are checked for sludging and sent out for dielectric tests.

What electrical PM do you perform on feeders and disconnect switches?

Feeders receive an insulation-resistance test annually. Insulation-resistance readings are excellent indicators of conductor insulation condition. However, because of vast amounts of water used in most of our processes, a high-humidity level prevails. This high humidity will cause many different resistance readings. Because of this we don't keep insulation-resistance records.

Switches are inspected periodically. During this inspection, the electrician will clean out any dirt and look for loose connections or burned spots. During overhaul periods, all switches are completely checked. The electricians will inspect the fuses and fuse clips for corrosion, tighten all parts and thoroughly clean the switch.

Do dust-ignition proof and watertight equipment require special EPM?

This equipment also receives a visual inspection. We will not open pushbuttons or panels that have bolted gasketed covers because we might damage the seals. On our annual overhaul, we check gaskets and examine the interiors of this equipment.

Describe a typical motor inspection procedure.

First, we make sure that the motor and surrounding area is clean. Next, if the motor is running, the electrician will check the motor temperature by placing his hand on the motor frame. If he can keep his hand on the motor, he assumes that the motor temperature is normal. He'll also use his sense of smell to detect possible overheated or burning insulation. If the motor appears overheated, the electrician will take an ammeter reading, or consider bearing trouble. If bearing trouble is suspected, he will place one end of a metal rod (½ in. dia. by 3 ft) on the bearing housing. The other end is held against his ear. If a thumping sound is heard, it indicates a flattened spot on the bearing; if a grinding sound is heard, it indicates lack of lubrication.

How often do you lubricate motors?

We follow the manufacturer's recommendations to the letter. In general, motors that run continuously receive lubrication every six months. All motors receive lubrication annually, if required. For motor lubrication, the use of the correct weight lubricant is of paramount importance. Before lubricating a motor, the electrician will check the equipment card to obtain lubrication data and instructions.

What spare parts do you keep?

The spare parts list includes several hundred different items. The purchasing department and stock clerks keep records of a minimum-maximum level of all spare parts. If a part is not used during a 12-month period, it is dropped from the active file unless it is an important part that must be immediately available to insure rapid replacement in case of a failure.

In our spare motor pool, there is a duplicate for practically every type of motor. A special card file notes the location, type and condition of each motor.

In each building, an electrical spare-parts locker contains certain parts such as fuses, overload relays, contacts and other parts that may require frequent replacement.

Do you have an electrical safety program?

We stress the use of electrically-safe equipment. For example, electricians are not allowed to use metal-cased flashlights or metal ladders. And all wooden ladders must be thoroughly varnished to preclude moisture. Safety equipment such as high-voltage gloves and voltage testers must always be used and checked regularly. And we spot-check the men to be sure that they use proper flag-and-tag rules when working on electrical circuits.

• *ESTIMATING FORUM—XIII*

Estimating Productivity of Mechanics

Part III—Appraising Crews

By Ray Ashley, *Research and Consulting Engineer, Oak Park, Ill.*

STATEMENT: **To evaluate productivity, there must be a standard to use as a gauge. Lacking one, we must establish a base to work from. For our purpose, let's use 100% as the productivity realized when the following stipulations are met:**

1. **Labor market favorable (no mechanics in the lower 10% bracket are required).**
2. **Industrial projects requiring not more than 50 mechanics.**
3. **Support of mechanics in the field, good.**
4. **Material deliveries, timely.**

These conditions establish a standard in line with that normally used by the better estimators.

QUESTIONS: **What productivity rating could be expected under the following conditions?**

A. Jobs using 8- or 10-man crews of a contractor's regular mechanics—labor market bad.
B. Jobs requiring 30-to 50-man crews—labor market bad.
C. Jobs requiring more than 50 mechanics—labor market bad with hectic conditions such as existed during and after World War II.

ANSWERS:

A. 100% to 110%
B. 80% to 85%
C. 60% to 70%

DISCUSSION:

While there is much talk about the abuse of time by mechanics, we must not become prejudiced against electricians in general. The laxity of a few men interferes with the work of many and reduces the productivity of an entire crew. To study this more thoroughly, let's take each of the previously mentioned conditions in order.

Condition A

Condition of the labor market has little or no effect on the attitude of the better mechanics. They are not the type that "let down" because they think their employer cannot get along without them.

It is not uncommon to have small crews of regular mechanics producing better than the 100% standard. This is to be expected because the standard is based on their better-than-average ability offsetting the short-comings of the poorer workmen.

Productivity of the better mechanics will fall off only when they are hampered by unskilled and indifferent men, procurement failures (untimely material deliveries), slow progress of the project, or some other reason beyond their immediate control.

Condition B

In normal times, a 50-man crew must absorb some of the less skilled mechanics. When the labor market is bad, it also must include some indifferent help and part time wiremen. Lack of skill in this assortment not only slows the work but affects the regular men who must take time to help and direct the newer mechanics. Result: lost time and possible loss of interest by the "regulars."

Estimated productivity (using 100 working hours as an example) of the 50-man crew discussed above would be determined approximately as follows:

20 men @ 95%	— 1900	manhours
20 men @ 80%	— 1600	manhours
10 men @ 60%	— 600	manhours
50 men	Totals 4100	manhours

Thus, the estimated average productivity of the crew would be 82%.

Condition C

During the hectic periods of World War II, and immediately after, productivity was influenced by numerous factors beyond the control of the mechanics. Material deliveries were untimely. Other trades could not cooperate 100%. There was general confusion and, at times, support of the men in the field was not at its best.

In Electrical Estimating (McGraw-Hill Book Co.), the following items are listed as being responsible for the 70% productivity rate in 1946:

Cause of Reduction	Percent Loss
Delayed and untimely material delivery	7
Lack of coordination of other trades	5
General confusion on the job	3
Labor market	15
Total	30

There were many complaints about extremely low output during the last war. The writer is familiar with two projects with a reported 50% productivity rate. The following serious conditions contributed substantially to this record:

1. Jobs were overmanned.
2. Material deliveries were unbalanced and untimely.
3. The state of confusion affected all trades.

The contractors were not in position to build up crews and add men in line with their best judgment. Contracts were of the cost-plus type and the authorities constantly called for more men. The resultant over-manning virtually invited a slowdown.

Some equipment and materials were shipped far ahead of time and had to be stored and protected until installed. The added labor involved was just so much excess load on the mechanics.

Perhaps much of the confusion could not have been avoided in the understandable haste to get things done. But, the factors noted above created conditions and productivity hazards that the best of crews could not have coped with.

Table I
Variations in Work-Day Practices **
(Non-installation time)

Operation	Time in Minutes A	B	C
Changing clothes—in morning	15	..	..
Selecting tools and getting on the job	15	10	5*
Coffee-break—9:30 AM	15	10	..
Preparation for lunch	15	10	5
Return to work after lunch	15	5	..*
Coffee-break—2:30 PM	15	10	..
Pick-up and prepare to leave—afternoon	20	15	5*
Relief periods	30	20	15
Sitting around waiting for 4:30	10	..	..
Totals	**150**	**80**	**30**

Notes:

A—From current projects (unusual)
B—Suggested standards
C—From 1938 projects (unusual)
***—Medium size industrial projects*
**—Partially or wholly on mechanics' time*

TABLE II
Distribution of Time
(8-hour day)

Operation	Time in Minutes A	B	C
Actual installation time	330	400	450
Normal incidental time	60	60	30*
Special allowance—coffee breaks	20	20	..
Wasted time	70	..	..
Totals	**480**	**480**	**480**

Notes:

A—From current projects (unusual)
B—Suggested standards
C—From 1938 projects (unusual)
**—Unusual condition*

Extreme vs. Standards

Too often, opinions of conditions in general are formed from studies of extreme cases. Tables I and II provide comparative studies of such extremes with a reasonable standard. Each Table has three columns representing the following:

Column A—Reported conditions on some current projects.
Column B—Suggested standards.
Column C—Reported conditions on some 1938 projects.

Table I shows variations in work-day practices listing the mechanics' non-installation activities. Table II shows the distribution of time for an 8-hour day including installation, incidental, coffee-break and wasted time. Explanation of the three sets of values in each table follow.

(Continued on page 165)

"GOOD MORNING, MR. PROSPECT, I am Rita Brown of the Krug Maintenance Company. We have a program for lighting maintenance which can save you money."

Boosting work volume with . . .

Salesladies For Lighting Maintenance

Here's how Krug Maintenance Company, Inc., Brooklyn, N. Y., has organized an outside sales force of four salesladies to canvass the widespread market for contract lighting maintenance.

FOUR ladies are today doing a mighty effective job of selling lighting maintenance for Krug Maintenance Company, Inc., Brooklyn, N. Y. Their performance has proved not only that women can do this semi-technical sales job, but that the pleasant feminine touch is a definite asset in the sales approach.

The lighting division of the company is under the sales direction of Herbert Wohlman, who conceived the idea of using salesladies. The details of his organizational structure are as follows:

1. The four salesladies report to Wohlman in the performance of their selling job.

2. Each of the salesladies has been carefully schooled by Wohlman in the essential technology of their job. Over a one-week training period, they have been taught the fundamentals of modern lighting. This includes evaluation of such characteristics as footcandle levels, brightness ratios, reflectance factors, maintenance factors and efficiency and economy considerations. In addition, they have developed an extensive understanding of the various luminaires, diffusers, lamps, ballasts, accessories and other equipment concerned with the task of lighting maintenance. They know equipment specifications and operating characteristics. They know how to select and apply equipment for various lighting design objectives. And they understand the details of luminaire mounting and installation. Of course, questions may arise from time to time about some technical point which, at the time, the particular saleslady is unable to answer. In the relatively few cases of this type, the engineering staff of the company can quickly and surely solve any problems. And as time goes on, the special problems will become part of each salesladies' experience, adding to her fund of knowledge on the subject.

3. Each saleslady has also been fully trained in the mechanics of sales negotiations. This includes general training in selling—how to explain the advantages and how to demonstrate the economy of lighting maintenance on a contract

basis. They are trained in pricing the various details of lighting maintenance—pricing labor and materials to come up with the annual cost of the contract for the particular customer. In the area of pricing, each saleslady is authorized and fully qualified to make firm agreements on all routine maintenance and on any special maintenance.

4. Each saleslady is responsible for a well-defined geographic area. Her job is to contact industrial plants, stores, office areas and all other commercial and industrial users of large amounts of fluorescent lighting. She arranges for a personal interview with the appropriate authority to explain contract lighting maintenance. Then she follows up with a visit to the prospective customer to sell the maintenance contract. Equipped with a loose-leaf binder of manufacturer's product literature, she discusses the customer's need for lighting maintenance and fills out a survey form to arrive at the material and labor costs involved. The customer is then presented with a contract form which he signs. The contract form is returned to the home office and, by a regular procedure, the new customer's plant (or office, or store, or etc.) is included in the working schedule of Krug's maintenance mechanics.

5. Once a prospect comes under a maintenance contract, the saleslady makes a practice of checking with the customer from time to time to assure his complete satisfaction with the maintenance program.

6. Remuneration for the salesladies is made on the basis of draw against commission. Such an arrangement provides an effective incentive for each saleslady and does offer an attractive income.

According to Herb Wohlman, the use of salesladies in selling lighting maintenance has worked out fine. They have demonstrated ability to do the job as well as, if not better than, men. And customer reaction has been highly favorable.

"CONTRACT MAINTENANCE is the modern, economical way to keep fluorescent lighting systems operating at peak efficiency. Let me demonstrate how our program reduces cost of maintenance, increases light output, reduces equipment failures and damage, provides for all emergencies, stimulates employee productivity and adds many other benefits." Complete explanation of the contract lighting maintenance program is made by Rita Brown to this prospective customer. After full explanation, discussion of the customer's needs for lighting maintenance and a lighting survey of the customer's plant, the complete lighting maintenance program is set forth, with its cost, in a contract which is signed by the customer.

"THANK YOU for signing up for our lighting maintenance program. We will immediately work out a service schedule of regular lamp and luminaire cleaning, lamp replacement and electrical inspection. We are sure you will soon recognize all of the economies of contract lighting maintenance."

CONTINUAL STUDY of lighting equipment is part of each salesladies job, to supplement the initial week of intensive training she received. Here, Herb Wohlman, manager of the lighting division, is pointing out some important characteristics of a fluorescent assembly to be used on a typical job.

Determining Power

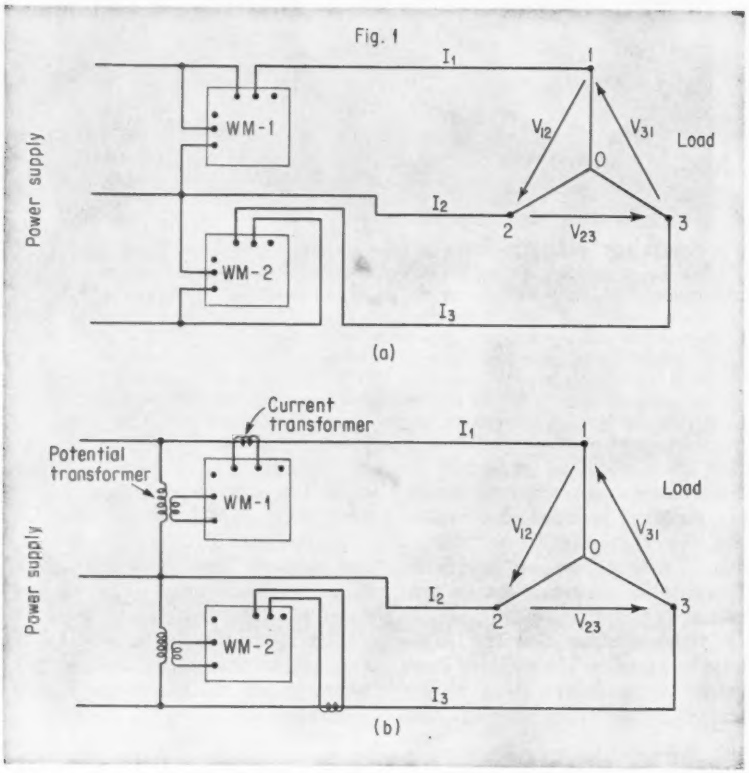


FIG. 1—Two-wattmeter method of measuring three-phase power. Connections are shown (a) for direct-connected meters and (b) for meters requiring potential and current transformers.

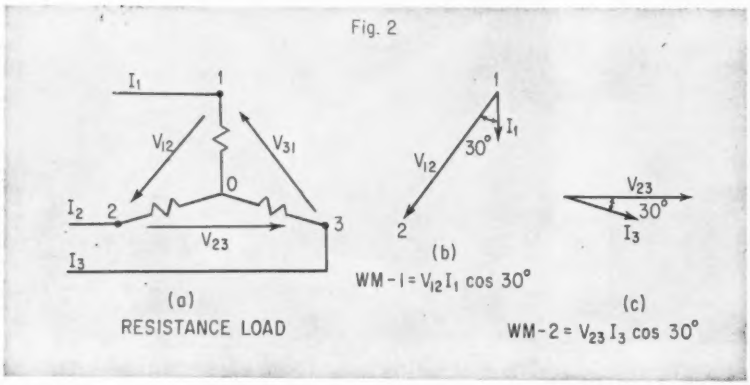


FIG. 2—Resistance load vector diagrams showing relation of voltage and currents at wattmeter for balanced voltage and current conditions. Formulas (2) and (3) of text refer to these diagrams.

A useful method of determining load power factor with two wattmeters and a "ratio of wattmeter readings" curve.

By R. C. Moore,
Motor and Generator Department, Allis-Chalmers Mfg. Company, Milwaukee, Wis.

QUITE often a check of power factor conditions in a plant becomes important. This may involve specific equipment such as induction motors, a portion of the electrical system, or the complete system. Such an investigation may be carried out to check contract guarantees, evaluate effects of overmotoring, or other reasons.

Power factor meters give direct indications, but such instruments may not be readily available. Then other methods must be used. The two-wattmeter technique is fairly common and determination of power factor from the ratio of the two-wattmeter readings is the subject of this discussion.

Measurement of power to a 3-phase motor are often made by the two-wattmeter method shown in Fig. 1-a or 1-b[1]. The direct meter connections of 1-a may be used when voltage and current values are within the wattmeter range. Several wattmeter terminal posts may be available for both voltage and current connections. A connection multiplier for the meter terminals used may be determined from instruction on the inside of the meter-case cover. The wattmeter reading then is:

Watts = (needle scale reading) × (meter connection multiplier)

Factor From A Graph

When line potentials and currents exceed values permitted for direct wiring to the meter, potential and current transformers may be used as indicated in 1-b. The wattage may then be calculated as:

Watts = (needle scale reading)
× (meter connection multiplier)
× (potential transformer ratio)
× (current transformer ratio)

When voltage and current are known, load power factor of a 3-phase circuit may be calculated from the following formula:

$$\text{Power Factor} = \frac{\text{watts}}{\text{volt-amperes}} = \frac{\text{Algebraic sum of wattmeter readings}}{\sqrt{3}\,V\,I_L} \quad (1)$$

Where: Wattmeter readings are from Fig. 1.

V — is line-to-line voltage
I_L — is line amperes

Equation (1) requires a knowledge of line voltage and current to determine load power factor. This is not always necessary. When the power system has balanced voltages and supplies balanced line currents to a load, such as an induction motor, power factor may be determined from the ratio of the two wattmeter readings.

Power Factor from Wattmeter Ratios

The following examples illustrate a method of determining load power factor from the ratio of the two wattmeter readings of Fig. 1. First, a balanced resistive load will be considered; then a combined resistance and reactance load such as an induction motor. The wattmeter connections of Fig. 1 and vector diagrams of Figs. 2 and 3 will be used.

Resistance Load—The load currents and voltages for a resistance load may be drawn in vector form as shown in Fig. 2-a. In 2-b the potential and current vectors of Wattmeter Wm-1 are V_{12} and I_1, respectively, with a 30° phase angle between the vectors. Similarly in 2-c, wattmeter Wm-2 potential and current values are represented by vectors V_{23} and I_3, respectively, with a 30° phase angle between.

Therefore, power readings are:

Wm-1 Watts = $V_{12}\,I_1\,\text{Cos}\,30°$
Wm-2 Watts = $V_{23}\,I_3\,\text{Cos}\,30°$

For balanced line voltages and balanced currents:

$V_{12} = V_{23} = V$ and $I_1 = I_3 = I$

Then:

$$\text{Ratio: } \frac{\text{Wm-1}}{\text{Wm-2}} = \frac{V_{12}\,I_1\,\text{Cos}\,30°}{V_{23}\,I_3\,\text{Cos}\,30°} = 1.0 \quad (2)$$

Also:

$$\text{Load Power Factor} = \frac{(\text{Wm-1})+(\text{Wm-2})}{\sqrt{3}\;V\;I} = \frac{2VI\,\text{Cos}\,30°}{\sqrt{3}\;V\;I} = 1.0 \quad (3)$$

Resistance and Reactance Loads—An impedance load consisting of resistance and inductive reactance (induction motor) is shown connected across a balanced voltage supply in Fig. 3-a. The voltage and current vector relationship for wattmeter Wm-1 (see Fig. 1) is indicated in 3-b. Wm-1 then reads:

Wm-1 Watts = $V_{12}\,I_1\,\text{Cos}\,(30° + \theta)$

Where: θ—is the power factor angle of the load; the angle by which the impedance load current I_1 lags behind the impedance voltage V_{10}.

Similarly, the voltage and current vector relationship of wattmeter Wm-2 is shown in 3-c. This meter reads:

Wm-2 Watts = $V_{23}\,I_3\,\text{Cos}\,(30° - \theta)$

Where: θ—is the angle of lag of the impedance current I_3 behind the impedance voltage V_{03}.

For a balanced impedance load and supply voltage:

$V_{12} = V_{23} = V$ and $I_1 = I_3 = I$

Then:

$$\text{Ratio: } \frac{\text{Wm-1}}{\text{Wm-2}} = \frac{V_{12}\,I_1\,\text{Cos}\,(30° + \theta)}{V_{23}\,I_3\,\text{Cos}\,(30° - \theta)} = \frac{\text{Cos}\,(30° + \theta)}{\text{Cos}\,(30° - \theta)} \quad (4)$$

$$\text{Load Power Factor} = \frac{(\text{Wm-1})+(\text{Wm-2})}{\sqrt{3}\;V\;I} = \frac{VI\,[\text{Cos}\,(30°+\theta)+\text{Cos}\,(30°-\theta)]}{\sqrt{3}\;V\;I} = \frac{\text{Cos}\,(30°+\theta)+\text{Cos}\,(30°-\theta)}{\sqrt{3}} \quad (5)$$

Values of load power factor angle θ may be assumed to evaluate equations (4) and (5) which may then be plotted in curve form as shown in Fig. 4.

The curve of power factor vs wattmeter ratio is a useful reference. The following discussion indicates how the readings of the wattmeters of Fig. 1 may be expected to vary with load; and how power factor for various motor loads may be determined from the curve of Fig. 4.

We may assume that the two-wattmeter method of Fig. 1 is used to measure power to a fully loaded induction motor and that the current and potential transformer ratios and meter mutipliers are similar. Motor power input may be determined from the sum of the wattmeter readings. Motor power factor may be determined from the ratios of the wattmeter readings using the curve in Fig. 4.

For motor operation at 100% power factor, both wattmeters read the same and the ratio of wattmeter readings is 1.00 which may be checked on the Fig. 4 curve.

In the usual induction motor case, the motor power factor at full load is less than 100% and one wattmeter (say Wm-1) reads less than the other meter (Wm-2). Thus, if the ratio of the readings Wm-1/Wm-2 is 0.57, reference to the curve shows the motor power factor to be 85%. On further reduction of motor load both wattmeter readings decrease in value with Wm-2 continuing to read higher than Wm-1.

As motor loading is further reduced, a condition may be reached when the Wm-1 reading decreases to zero. All the power input to the motor is then determined from the other wattmeter readings. Since

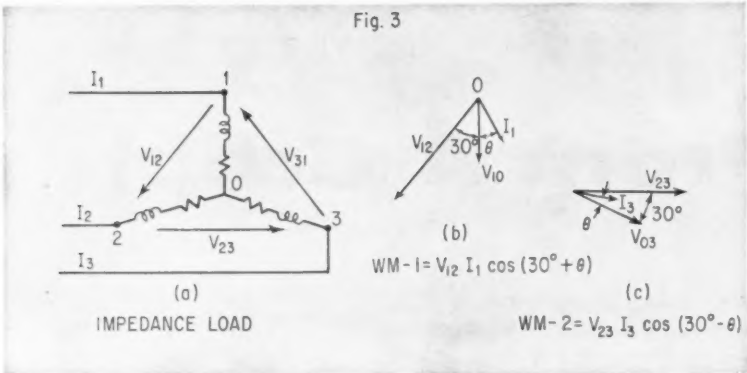


FIG. 3—Vector diagrams for an impedance load consisting of resistance and inductive reactance show relation of voltage, current and power factor angle Θ. Formulas (4) and (5) of text refer to these diagrams.

the ratio of the two meter readings is "O", motor power factor is 50% as determined from the curve.

On still further decrease of motor loading, the reading of wattmeter Wm-2 continues to decrease in value. The reading of Wm-1 tends to "change sign" or read lower than the "O" mark on the meter scale. The meter needle may be brought back on scale by reversing either the voltage or the current connections at this meter. Motor power input may then be determined from the difference of the two meter readings. Power factor may also be determined from the ratio of the meter readings (with a negative sign assigned to the low meter reading) by referring to Fig. 4.

Thus, when a motor load is decreased from full to light values, one wattmeter always reads higher than the other. Furthermore, this meter always reads positive and does not tend to read lower than "O" as the other meter does for motor power factors less than 50%.

As another example, the power factor of an initially lightly loaded induction motor increases with increasing load in most applications. When the load on the motor increases, the motor power factor may pass through the 50% value and one wattmeter reading then reverses. Before reversal, the wattmeter readings are subtracted. After reversal, the readings are added to obtain motor power input.

Occasionally uncertainty may exist as to whether the two-wattmeter readings are to be added or subtracted for a change in motor loading. Such cases may arise when the power factor is in the vicinity of 50%. Several methods of testing to verify the sign of the meter readings are available.[2]

PF from Single Wattmeter

The curve of Fig. 4 may also be used to determine power factor when only one wattmeter is available, provided the meter is switched or located by other means—first in one, then in the other, of the required meter locations shown in Fig. 1. If this is done, the two required wattmeter power readings may be obtained with one meter and the circuit power factor may be determined from Fig. 4. Since simultaneous meter readings are not obtained by this method, there is a chance for error in power factor determination should load vary in the time interval between the two sets of readings.

Motor Current from PF Curve

Motor current may also be determined from the wattmeter readings and the curve of Fig. 4, if the readings are obtained on a circuit of known voltage. With the voltage known and the power factor obtained from the curve, the following formula is used:

$$I = \frac{\text{watts}}{\sqrt{3}\ V\ pf} = \frac{(Wm\text{-}1) + (Wm\text{-}2)}{\sqrt{3}\ V\ pf}$$

Where:

V — is line-to-line voltage
pf — is the power factor from Fig. 4
I — is the motor line current

References:

(1) Master Test Code for Electrical Measurements in Power Circuits, AIEE No. 552—Nov. 1955 (American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y.)
(2) Standard Handbook for Electrical Engineers, McGraw-Hill Book Co., Inc., New York, N. Y.

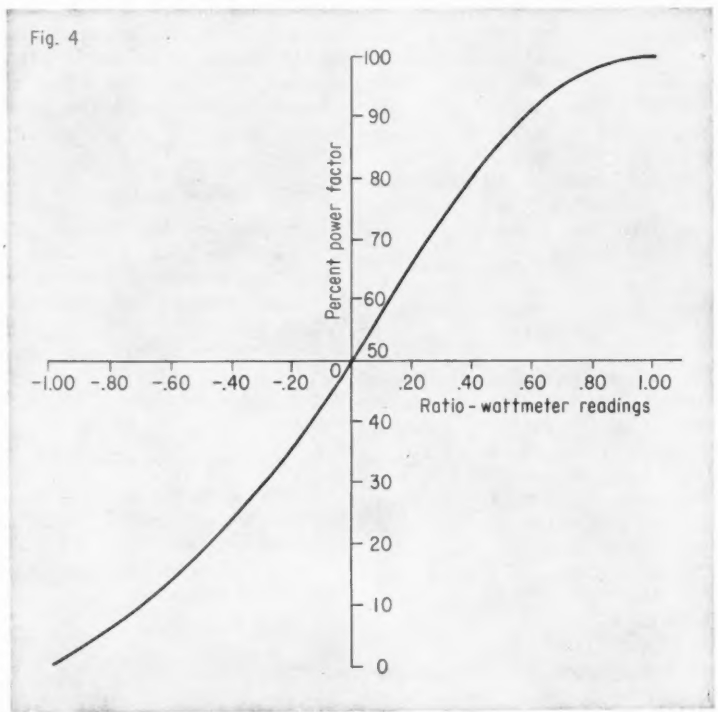


FIG. 4—Reference curve of power factor vs ratio of wattmeter readings. When ratio of meter readings in Fig. 1 is known, power factor of the load may be determined from this curve.

Houses for Electric Heating Research

Initial results of extensive test program in two Minnesota houses occupied by "ghost" families.

INITIAL reports of tests conducted on two electrically heated test houses built by the Wood Conversion Co., St. Paul, Minn., provide interesting and valuable data on heater performance, insulation effectiveness, temperature control, sun and wind effect, heating costs, and heat loss.

This scientifically planned and controlled $250,000 program, begun in the fall of 1959, included elaborate provisions for simulated occupancy, moisture generation, operation of electrical appliances, and controlled door openings—as well as a complete complement of devices for measuring electrical demand and energy consumption and for recording temperatures, humidity, wind speed and solar heat. These measurements were to provide data for the accurate comparison of heat loss in the two houses under various preset conditions; for study of wall, ceiling, floor, attic, crawl space, and earth temperatures for different operating conditions; and for determining limiting relative humidities under preset conditions.

The two homes, built on adjacent lots on the edge of Stillwater, Minn., face north. Construction is identical, except for differences in thermal insulation used. Balsam-wool products of different thicknesses manufactured by the company, with and without reflective liners, were installed to provide performance data under actual conditions of use. Laboratory hot-box tests of the insulating products yielded the U-values shown in Table 1, which were used in calculating design heat losses.

Fig. 1 shows floor plans, general construction, and insulating details of the two houses. Heating design data for the above-grade rooms are given in Table 2. Heating equipment was also provided to fully heat the below-grade rooms; design data and results of tests conducted in these rooms will be given in a subsequent report.

TABLE 1. Insulation Schedule

House	Construction	Thickness (in.)	Liners	Hot-box U-Values* (Btuh/sq ft/deg TD)
A	Ceiling	5	Reflective	.046
	Walls	3⅝	Regular	.057
	Floor	2	Regular	.082
B	Ceiling	3⅝	Reflective	.056
	Walls	2	Reflective	.066
	Floor	1	Reflective	.071

* Hot-box tests were made on insulated 5½ x 6-ft panels including 10% wood framing.

Load Simulation

These houses were unoccupied during the first winter except for the "ghost families" created by load-simulating equipment. Normal expected internal heat and moisture gains from a family of four, from lighting, and from miscellaneous appliances were simulated using small resistance heaters and humidifiers and by regular scheduled operation of major appliances and showers (see Tables 4 and 5). Daily door-openings were controlled by project engineers and recorded by means of mechanical counters on each door. A camera, set up in the basement laundry room, was timed to photograph all kilowatt-hour and demand meters each midnight to provide a daily running record of energy usage.

More than 300 copper-constantan thermocouples were placed on and in walls, ceilings and floors, on thermocouple "trees" in each room, outdoors, in the crawl space, attic, and buried in the earth. Two recording potentiometers automatically recorded temperatures indicated by 78 of these couples every 24 minutes; the others were read manually using a portable potentiometer each week or when information was required. In addition, recording thermometers and hygrometers in the living room of each house provided continuous strip charts of air temperatures.

Outdoors, a sheltered resistance-type thermometer recorded air temperature every 2½ minutes; a 30-ft weather mast mounting a wind speed and direction indicator and a 10-junction pyrheliometer provided wind and solar heat data.

Test Results

Although both houses were operated uniformly, the conditions were varied during the heating season to provide 15 phases of operation or testing periods. For example: there were periods when no simulated internal heat loads were used; window glazing was varied using double and triple glass; interior doors were kept open during some periods, closed in others; basement was alternately heated and not heated. As a result, the extensive recorded data may be sorted and analyzed at any time to permit investigation of any aspect of these operating conditions. Only part of this data has been checked; some important initial findings are reported here.

Heating Energy: Still of significant importance to the prospective user of electric space heating

FIG. 1 Floor Plan and Elevation

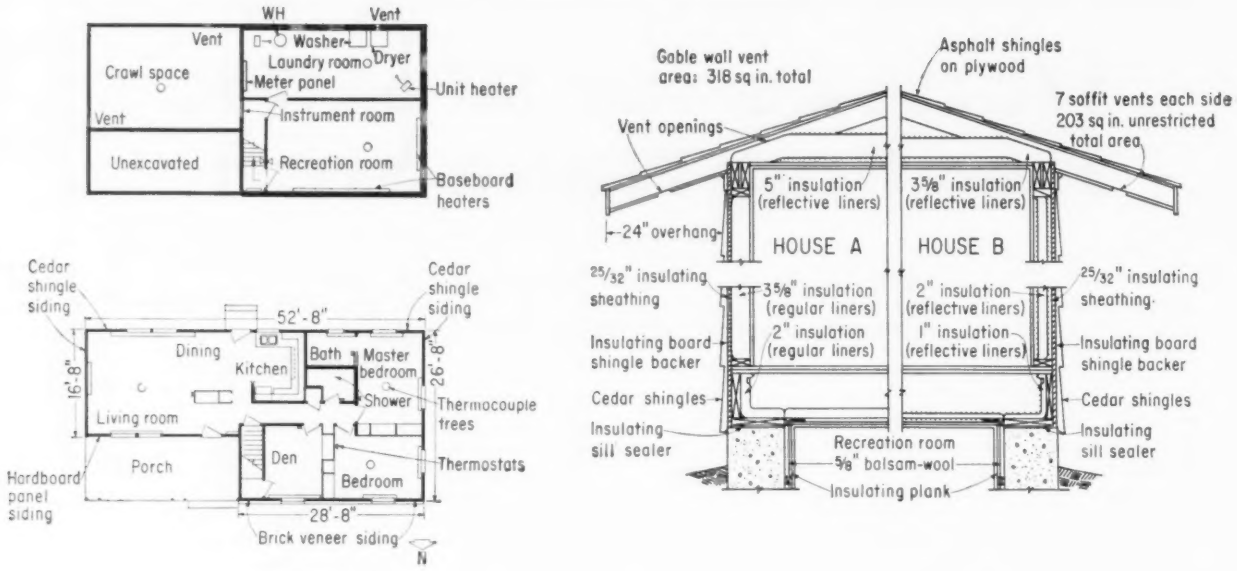


TABLE 2. Design Data

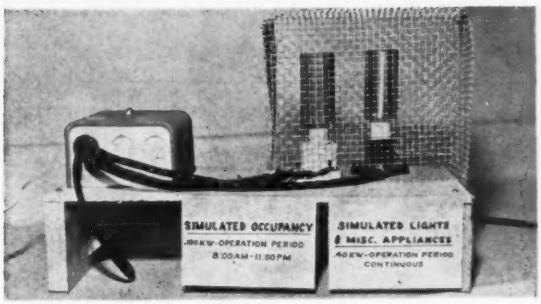
Room	Area (sq ft)	Design Heat Loss ½ Air Change Btuh	½ Air Change Watts	½ Air Change Watts/Sq ft	1 Air Change Btuh	1 Air Change Watts	1 Air Change Watts/Sq ft	Installed Capacity Btuh	Installed Capacity Watts	Installed Capacity Watts/Sq ft
House A								**Both Houses**		
Living Room	448	13,552	3,971	8.9	16,498	4,834	10.8	15,017	4,400	9.8
Kitchen	106	2,293	672	6.6	2,992	877	8.3	2,730	800	7.6
Master BR	160	4,249	1,240	7.8	5,294	1,551	9.6	5,461	1,600	10.0
Master Bath	42	1,113	326	7.8	1,386	406	9.7	1,707	500	11.9
Bedroom	150	4,059	1,189	7.9	5,045	1,478	9.8	5,461	1,600	10.7
Den	142	3,553	1,040	7.3	4,734	1,387	9.7	4,266	1,250	8.8
Shower	36	447	131	3.6	683	200	5.6	1,707	500	13.9
Totals	**1,084**	**29,266**	**8,580**	**7.9**	**36,633**	**10,739**	**9.9**	**36,349**	**10,650**	**9.8**
House B										
Living Room	448	14,126	4,139	9.3	17,071	5,001	11.2			
Kitchen	106	2,413	707	6.7	3,112	912	8.6			
Master BR	160	4,485	1,314	8.2	5,529	1,620	10.1			
Master Bath	42	1,178	345	8.2	1,451	425	10.2			
Bedroom	150	4,335	1,270	8.5	5,321	1,560	10.4			
Den	142	3,829	1,122	7.2	5,010	1,468	10.3			
Shower	36	474	139	3.9	710	208	5.7			
Totals	**1,084**	**30,840**	**9,034**	**8.4**	**38,204**	**11,193**	**10.3**			

Normal DD (complete heating season):	7700
Outdoor design temp:	−20F
Indoor design temp:	
Above-grade rooms:	70F
Below-grade rooms:	50F

Notes: 1. Calculations are based on double-glazed windows and storm doors. For triple-glazed windows, subtract 3,419 Btuh (1002 watts) from total heat loss.

2. Living-room area and heat loss include 68-sq-ft entrance hall.

3. Installed capacity is identical in both houses.



BODY HEAT, lighting and small appliances were simulated by automatic control of small cone heaters.

is the question, "What will be my annual heating cost?" Metered heating energy used in the above-grade rooms of the two houses, November through May, was as follows:

House A: 11,830 kwhr.
House B: 12,540 kwhr.

This 5.5% difference in energy consumption, due mainly to the heavier insulation in the ceiling of House A, would represent a $10 to $12 saving annually for a normal complete Minneapolis-St. Paul winter.

These kwhr figures serve to show the difference in insulating effect; however, they are not representative of annual operation. For example, after making adjustments for the abnormalities of operation due to the tests, for a complete heating season of 7700 degree-days, and for full family simulation and double glazing, House A shows actual annual consumption of 11,200 kwhr. This would represent a heating cost of $196 based on the Stillwater monthly electric heating rate of $13.75 for the first 500 kwhr and 1.75 cents per kwhr in excess of 500.

For 1,084 sq ft of heated floor area, the heat factor[1] would be 1.34 kwhr/sq ft/MDD. Compared to the usual country-wide figures of 1.8 to 2.2, the heat factors indicated are evidence of the benefits of the thorough, careful insulating and weatherproofing practices employed during construction. As shown in Fig. 1, particular attention was given to usually neglected areas of heat loss such as the inside of the headers and sills above the foundation wall. Also contributing materially was the use of insulating sheathing and insulating board shingle backer.

How does this adjusted annual figure of 11,200 kwhr for House A compare with estimates obtained using the NEMA formula? With a recommended

TABLE 3. Recorded Weather Data

	Nov	Dec	Jan	Feb	Mar	Apr	May
Ave. daily temp.....	25F	27F	15F	16F	20F	45F	57F
Degree-days.....	1181	1143	1525	1408	1381	589	260
Ave. wind speed (mph).	5.9	4.8	8.5	5.0	8.8	5.1	

Coldest temperature recorded: —20F on Jan. 4.
Total degree-days, Nov. through May: 7349 (8% above normal)

constant of 17, a design temperature difference of 90 degrees, 7700 degree-days, and a total heat loss of 10.739 kw at one air change per hour, the formula gives

$$\frac{10.739 \text{ kw} \times 7700 \text{ DD} \times 17}{90} = 15{,}600 \text{ kwhr.}$$

This is 29.3% higher than the test results. The two most likely reasons for this difference are (1) the actual air change is less than the one per hr assumed; (2) the constant of 17 used is too high to adequately account for the extra heat gains supplied by solar energy, appliances, body heat, etc.

If we rearrange the NEMA formula and solve for the constant, C, we can substitute the design conditions of Table 2 and come up with a realistic value for C which fits the actual results obtained in House A:

$$C = \frac{11{,}200 \times 90}{10.7 \times 7700} = 12.2 \text{ (1 air change)}$$

$$C = \frac{11{,}200 \times 90}{8.6 \times 7700} = 15.2 \text{ (½ air change)}$$

It appears that if one air change per hr is assumed, a constant of 12.2 will give accurate estimates, while a constant of 15.2 should be used if one-half air change is assumed.

It is important to know which is correct, however, since use of one-half or one air change will materially affect the installed capacity of the heating equipment. The data given in Table 6 can be used as a rough check on actual infiltration.

The tests in the den of House A showed the heating energy used with double glass on the windows to be 0.202 kwhr/DD during the test period or 187.5 kwhr for the 928 DD recorded. In addition (not shown in the table), 11.4 kwhr were supplied by the body-heat simulating heaters—a total energy input of 198.9 kwhr.

Average temperature difference during the period was 53.8 degrees:

TABLE 4. Occupancy Load Simulation (Family of Four)

Heater Location	Operating Period	Total Operation (hr per day)	Connected Load (watts)	Heat Simulation (Btu per day) Sensible	Latent	Total
Living Room.....	8 am–11 pm	15	150	5759	1920	7679
Kitchen.....	8 am–11 pm	15	100	3840	1280	5120
Master Bedroom.....	11 pm– 7 am	8	150	3072	1024	4096
Bedroom.....	11 pm– 7 am	8	100	2048	682	2730
Den.....	11 pm– 7 am	8	75	1536	512	2048
		Total heat input (Btu per day)				21,673
		Total heat input (kwhr per day)				6.35

$$\frac{198.9 \text{ kwhr}}{53.8 \text{ deg}} = 3.697 \text{ kwhr/deg TD.}$$

The test covered 19 days, or 456 hours:

$$\frac{3.697 \text{ kwhr/deg TD}}{456 \text{ hr}} = .0081 \text{ kw/deg TD} \text{ or } 8.1 \text{ watts/deg TD.}$$

Based on a 90-deg design TD, the total room design heat loss would be

$$8.1 \frac{\text{watts}}{\text{deg TD}} \times 90 \text{ deg} = 729 \text{ watts.}$$

From Table 2, this is considerably less than the calculated heat loss of the den at both one-half or one air change. It is to be expected that, because of the low average wind speed during this period, the actual transmission heat loss through the walls would be less than design U-values would indicate (due to lower surface film resistances); however, even with allowances for this factor, the actual air change indicated would be less than one-half. Hence for homes in this area of comparable size and insulated to the same degree, results of these tests indicate that heat-loss calculations based on one-half air change per hr and annual energy estimates using a NEMA constant of about 15 will give close heating cost estimates. Also, the one-half air change in heat-loss calculations will result in heater capacities closer to actual requirements.

This illustrates the value of records of metered heating energy to the refinement of estimating methods. Many such records, obtained for different structure types, different orientations, and various glass areas and degrees of insulation, would eliminate much estimating guesswork. Additional infiltration data is currently being obtained in the test houses with portable infiltration metering equipment utilizing a tracer gas technique to determine the rate of air change in each room. The results will be helpful in providing an answer to the much-debated air-change question in well insulated houses.

Double vs Triple Glass: A study of heat loss using double- and triple-pane windows was made possible through the installation of a third pane of glass to create two air spaces. Tests were made over two periods reasonably comparable as to weather conditions. During the first period, triple glass was used on the single window in the den; during the second period, the third pane was removed. Table 6 shows test results, indicating an energy saving of 12.2%.

The savings accomplished through the use of a third glass surface will vary with the room, depending upon the amount of ceiling, wall and floor insulation, the ratio of glass to wall area, and the orientation. The den window used for these tests was on the north wall, comprising 18.8% of the gross north wall area. A similar study made of the master bedroom, with windows on the south and west walls, showed less of an energy reduction using triple glass; however, this was due to the influence of solar radiation.

TABLE 6. Effect of Double and Triple Glass
Tests made in den of House A

	Double Glass	Triple Glass
Test period	Feb 4–Feb 23	Jan 18–Feb 4
Degree-days	928	835
Average outdoor temperature	16.2 F	15.2 F
Average wind speed	6.3 mph	5.1 mph
Heating energy		
kwhr/DD	.202	.180
kwhr/sq ft/MDD	1.42	1.27
Energy reduction, triple glass over double glass		12.2%

TABLE 5. Lighting and Appliance Load Simulation
(Family of Four)

Load	Total time connected per day	Connected load (kw)	Consumption per day (kwhr)
Actual Operation:			
Washer	50 min	0.30	0.25
Dryer	55 min	4.24	3.90
Dishwasher	50 min	1.02	0.85
Water heater	Automatic	2.60	14.16
Simulated Operation			
Refrigerator	12 hr	0.10	1.20
Freezer	Continuous	0.25	1.80
Range	100 min	2.00	3.40
Television	6 hr	0.15	0.75
Lights and Misc.	Continuous	0.14	3.36
Total daily consumption (kwhr)			29.67

We can check this 12.2% result from another direction using the NEMA formula with the 15.2 constant determined above at one-half air change per hr. Total heat loss of House A using triple glass would be 7597 watts at one-half air change (see Note 1 to Table 2). Substituting in NEMA formula gives 9,880 kwhr annual energy. This is 11.8% lower than the 11,830 kwhr metered with double glass.

Actually, the proper NEMA constant for use with triple glass would be less than 15.2, since the extra heat gains comprise a higher percentage of the house heat loss than with double glass. Use of a lower constant would thus give a lower annual energy figure, with a resultant savings greater than 11.8%. It appears, therefore, that the over-all energy saving for House A with triple glass is close to 12% compared with costs using double glass.

For houses with equivalent glass areas but less insulation, we could expect less of a saving, since the windows would represent a smaller proportion of the total heat loss.

Thus the percent savings increases as the thermal insulation is increased; however, the dollar savings may or may not increase, since the annual heating cost will be less for the better insulated house. It is certainly worthwhile during the design phase to calculate savings to be expected with triple glass and compare them with initial costs to determine the extent to which it can be economically advantageous, keeping in mind the added benefit of increased comfort due to higher inside surface temperatures and the higher indoor relative humidities possible without danger of condensation.

Results of tests on solar heat contributions and interior surface temperatures in these test houses will be discussed in a subsequent article.

[1]See "The Heat Factor," EHF No. 6, Dec., 1960.

Lighting for College Dramatics

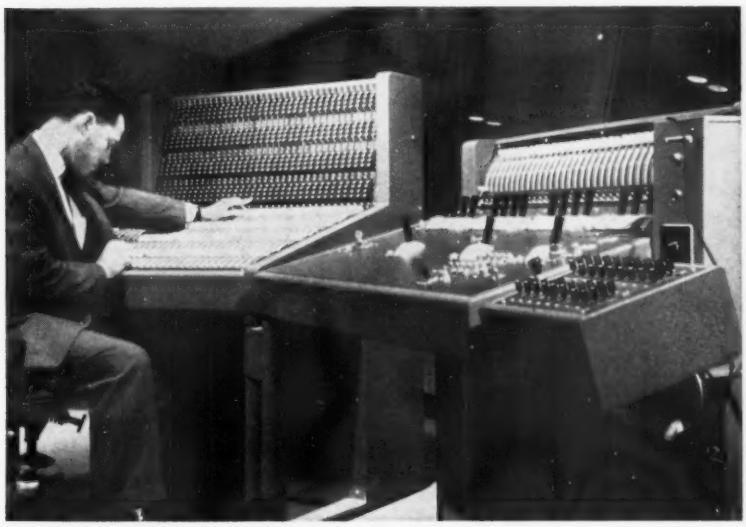
California State College dedicates modern speech-drama building containing theatre, radio and TV facilities that constitute "a major advance in theatre mechanization." Electrical contract handled by Fischbach and Moore represented 15% of building's total cost.

THEATRICAL, television, radio and musical facilities superior to many professional installations recently made headlines when San Fernando State College of Northridge, Calif., dedicated a new $2½-million speech-drama building. Termed "a major advancement in theatre mechanization" by "those in the know" from nearby Hollywood, the installation contains an array of modern lighting, control and air conditioning equipment in addition to a power distribution system which incorporates over 38 miles of cable and constitutes over 15% of the building's gross cost.

Within the structure, a 3600-sq-ft stage for the 400-seat "little theatre" is flexibly toplighted by three 40-ft battens which may be raised to the upper limit of a 60-ft-high stage loft, or lowered to within 5 ft of the stage floor for relamping or for interconnection of equipment to dimmers or directly to switched circuits. One batten is attached to a motor-operated catwalk, while main curtain and movie screen are similarly mechanized.

To prevent excessive festooning of flexible connection cables when battens are raised, conductors are grouped, intermittently banded, and maintained taut by spring-loaded reels and weighted halyards.

Additional stage illumination is projected from equipment located in a pair of fully air-conditioned ceiling-recessed lighting galleries above the orchestra pit. The various batten and gallery lighting units total 152 in number, ranging in wattage from 250-watt stationary spots to 2000-watt "follow" spots, and all equipped with full complements of color inserts.



MASTER CONSOLE in elevated booth of little theatre permits complete pre-setting of 4-scene presentation (left); manual control of lighting via scene master and submaster dimming levers (right); plus pushbutton reloading of circuits (foreground).

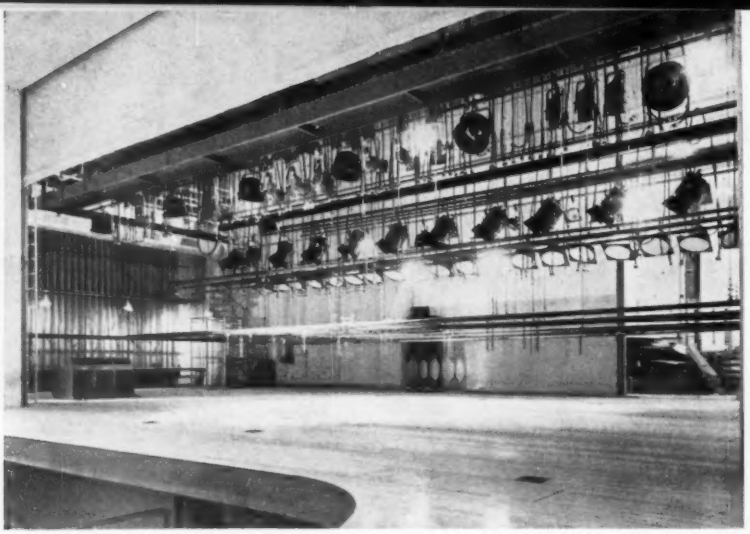
Two control booths, one for lighting and the other for audio, likewise share an area above the theatre's rear entrance, both booths being equipped with up-to-the-minute projection equipment and control consoles.

Control circuiting installed throughout the auditorium number 145, while over 2000 ft of rigid conduit is related to lighting circuitry plus intercom systems linking control booths with rear-stage and orchestra-pit stations.

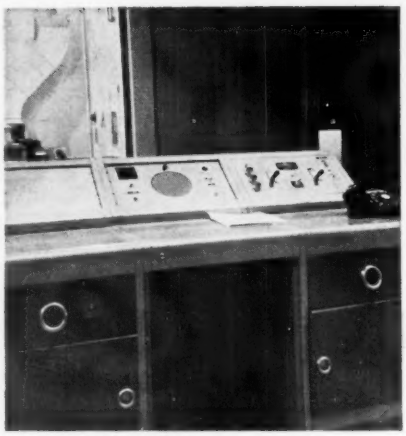
Combining esthetics with utility, the theatre obtains excellent acoustical properties through non-parallel placement of all ceiling and wall panels, plus special treatment of these surfaces.

For maximum stage-managing efficiency, a portable control console may be positioned in any desired backstage location, making it possible for a student manager to electrically control all lighting, scenery battens and curtain operations from this convenient spot.

Dimmer banks, controlled from either the portable stage console or from the rear-auditorium booth, are remotely located in a soundproof equipment room located in the basement beneath the stage.



FULLY MECHANIZED stage in college theatre has motorized light battens, catwalk, curtains and movie screen; all equipment controllable from either stage-manager's portable console or fixed master booth above rear entrances of 400-seat auditorium.



PORTABLE CONSOLE permits stage manager to control all lighting, curtain operations and scenery battens from desired location in wings or backstage area.

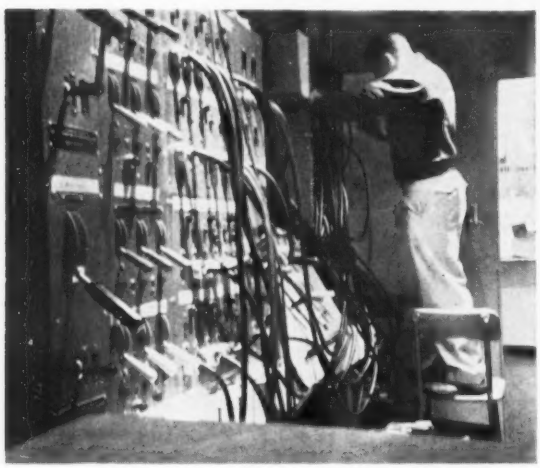
Dimmers are magnetic amplifier units, there being 27 3-kw and 11 6-kw units in this installation. In addition, this fixed dimmer installation is augmented by six portable dimmer panels which can be moved to any location within the speech-drama building, as desired. Two of these panels include six 6-kw dimmers each, while the remaining four panels have six 1000-watt units, a 6-kw master dimmer, plus all necessary control accessories.

Adjoining the theatre is a 200-seat music hall, with wall and ceiling areas similarly acoustically treated, and with house-lights controlled by motor-driven auto-transformers activated by pushbuttons from a stage control panel. Top-lighting for the 1250-sq-ft stage is provided by two stationary light battens, while local lighting is also available for illuminating individual music stands in a floor-recessed orchestra pit.

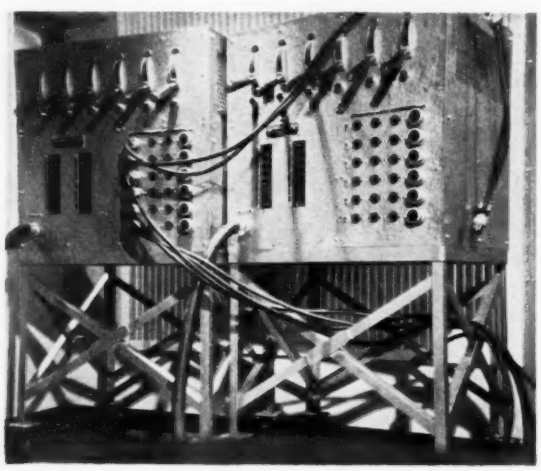
Perhaps the most unique facility in the building is an experimental theatre featuring a baffled ceiling that masks six 44-ft stationary lighting battens, thereby offering unlimited possibilities for unusual staging and lighting via 288 units connected to 36 circuits controlled from a separate soundproof control booth. Staging flexibility is also furthered by rearranging movable seating arrangements.

Comment is likewise in order concerning a 2400-sq-ft TV classroom-laboratory, toplighted by three 48-ft battens, each adjacent to a catwalk to facilitate connections and placement of flood- and spot-lighting equipment. In addition, two control booths are equipped with modern audio control panels, portable light-control consoles, record turntables and intercommunication systems.

Electrical contractors were Fischbach and Moore, with supervision by chief engineer Lawrence E. Grundy and project engineer Jerome B. Donohue. General contractors were Steel Brothers Construction Co., Alhambra, Calif.



EXPERIMENTAL theatre has separate control equipment in soundproof booth, with 288 items of lighting equipment connected to 36 circuits pertaining to six battens concealed by ceiling baffles. Flexibility for novel staging is also promoted by movable seats in this "theatre-in-the-round."



PORTABLE DIMMER panels can be moved to any desired location in the speech-drama building, making it possible for students to utilize equipment in variety of TV or theatrical production. Flexibility and quality of entire electrical installation compares favorably with professional standards.

How You Can Eliminate Fluorescent Ballast Noise Problems in Your Buildings

Today's trend toward higher levels of illumination—increasing the number of fixtures, lamps, and ballasts, or increasing the wattage of the lamp/ballast systems—makes fluorescent ballast sound a more and more important building consideration.

General Electric wants you to take full advantage of modern lighting levels. At the same time, you should assure yourself that you can solve any audible ballast "hum" problems in your lighting installation with minimum attention and effort.

ALL YOU HAVE TO DO IS . . .

1. Check each lighting installation *while it is still on the drawing board* with the General Electric Sound Rating Calculator* (see below) to predetermine whether ballast noise will be a problem, and . . .
2. Specify the appropriate *General Electric* sound-rated ballasts for the installation.

That's it. By properly following this two-step procedure, you can predict and overcome potential ballast noise problems before they exist.

General Electric, with five years of highly successful experience in the G-E Ballast Sound-control Program, is confident that this procedure will solve your ballast noise problems. Here's how the program works . . .

THE GENERAL ELECTRIC BALLAST SOUND RATING CALCULATOR is based on data gathered from hundreds of lighting installations over a period of many years. It provides a reliable index of the magnitude of audible ballast sound when room variables such as size, ceiling materials, and number of fixtures and ballasts are known. These calculations are keyed to . . .

GENERAL ELECTRIC'S BALLAST SOUND RATING SYSTEM. This system, initiated by General Electric in 1951, establishes a rigid scale of sound magnitude. Most General Electric ballast designs are carefully compared with this scale in actual fixture tests conducted in the only known anechoic sound chamber in the ballast industry. Each ballast design is thus "Sound-rated" "A" through "F," . . . "A" being quietest, and "F" being least quiet.

The sound-rating scale—and for that matter, the whole sound-control program—is not an industry standard. General Electric has established its own sound standards, and compares the performance of *General Electric ballasts* with these standards.

But the Sound-control Program doesn't end here. In order to give you further assurance that you get the "quiet" you specified, General Electric has established an elaborate . . .

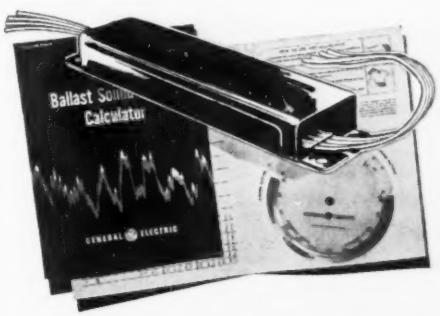
DAILY PRODUCTION SOUND AUDIT. A *daily* sample of production units is carefully compared in sound performance with the G-E sound-rating standard—under controlled conditions in the anechoic sound chamber. This close check on possible manufacturing variations means you get the kind of sound performance that your Sound Rating Calculator promised. The final element in G.E.'s Sound-control Program is . . .

BASIC ENGINEERING DESIGN. General Electric ballast design engineers are constantly examining today's ballast circuitry, trying to further minimize the inherent magnetic "hum" of core and coil assemblies. An example of the results of this engineering effort is the recently announced "A" sound-rated 40-watt, rapid-start line. This popular family of General Electric ballasts was granted a G-E "A" sound rating as a result of *basic circuit design* that produced a smaller and quieter core and coil.

Materials are also an important sound-control factor. For example, the resilient asphaltic filling compound used in General Electric ballasts maintains excellent sound-absorbing characteristics over the entire life of the product. The new General Electric Bonus Line† ballasts, using this proved asphaltic filling compound, are designed to provide protection against objectionable ballast end-of-life leaking and smoking, without sacrificing any sound performance.

All this means that General Electric is truly concerned about ballast sound—and is investing heavily so you can stop being concerned with it yourself. Mail the coupon today for your General Electric Sound Rating Calculator, and start using it immediately. For more details, ask your local General Electric Ballast Sales Engineer, or write Section 403-02, General Electric Company, Schenectady 5, New York.

† Trade-mark of General Electric Company.



GENERAL ELECTRIC SOUND RATING CALCULATOR

This ingenious device was designed so you can always predict *with 100% accuracy* whether a lighting installation will present noise problems. You can use it for any indoor lighting application from extra-quiet broadcast studios to noisy offices. On the easy-to-use circular slide rule you simply (1) dial in room "constant," (ability of room to absorb noise); (2) number of ballasts and their sound rating and (3) given ambient noise level for your application. Steps 1 and 3 are *immediately determined* from tables which are part of calculator.

PLEASE SEND ME THE FREE BALLAST SOUND RATING CALCULATOR

Mail coupon to: General Electric Co.,
Section B403-02, Schenectady 5, N. Y.

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COMPANY_____

ADDRESS_____

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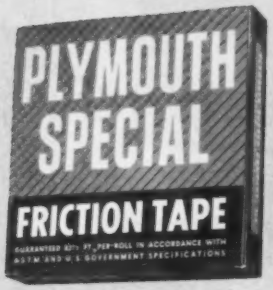
PLYMPRENE NEOPRENE SPLICING COMPOUND

A highly weather-resistant splicing tape for maximum protection against oils, alkalies and weather extremes.

PLYMOZONE SPLICING COMPOUND

For maximum high voltage resistance to ozone and moisture, Plymozone ozone-resisting splicing compound exceeds ASTM D-1373. Plymozone withstands four times the ozone concentration used as ASTM standard.



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.0085″ thick

No matter how cold the working conditions, Slipknot CW Vinyl Electrical Tape remains flexible and strips perfectly from the roll. A true all-temperature vinyl tape with an application temperature range of −14°F. to +176°F.

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The standard of the industry, in the FLIP-N-CUT® Instant Tape Dispenser. Resists water, acids, alkalies, oils, corrosion. Molds totally around any shape. Minimum dielectric strength of 10,000 volts.

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Bench Bender Speeds Deck Work

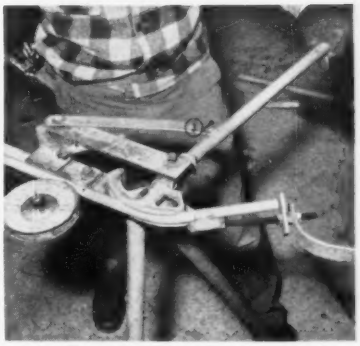
HAND bending is still recognized as the quickest and easiest way to make offsets in electrical metallic tubing, particularly in the small branch-circuit sizes. On projects where large numbers of identical bends are required, such as deck work on apartment buildings, some form of a centralized bending station is set up to handle these repetitive operations on a mass-production basis.

Such a facility was used by Gilbert-Hodgman, Inc., Chicago, project electrical contractors on a 20-story reinforced-concrete apartment structure. To speed up raceway fabrication for deck installation, job foreman Robert Opfer transformed a conventional EMT bending tool into a handy bench bender. Tubing was cut, reamed, bent and bundled at this station. Both 90° and 45° offsets were formed. The 45's provided laterals to baseboard outlet boxes to keep them above slab level and to permit final flush alignment with partition surfaces.

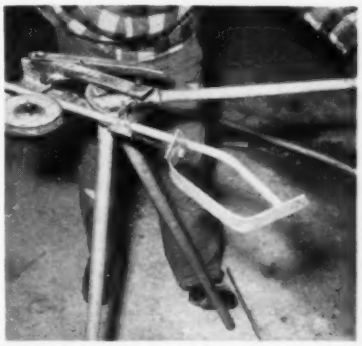
Basic support for the bender bench is a rigid-conduit "horse" consisting of a 10-ft ridge of 1½-in. pipe; two 1-in. conduit legs in front (under bender); and two ¾-in. conduit legs in back. Three conduit couplings welded together to form an inverted-V provide "sockets" for the legs. The bender assembly rests on the front legs. The remainder of the horse supports an 8-ft by 2-ft table of ¾-in. plywood fastened to a welded bracket at the rear and a pipe clamp up front. This provides space for a tubing vise, cutting and reaming tools and a flat surface for tubing being fed into the bender. Table and bender are 41 in. above floor level.

All bending is done in a horizontal plane at convenient working height. The bending tool pivots about a bolt through a steel assembly which also supports a tubing guide sheave and two bending-arm "stops." One stops lever-arm travel at the proper point for a perfect right-angle bend. The other, a notched, pivoted flat bar can be swung into place for 45° offsets.

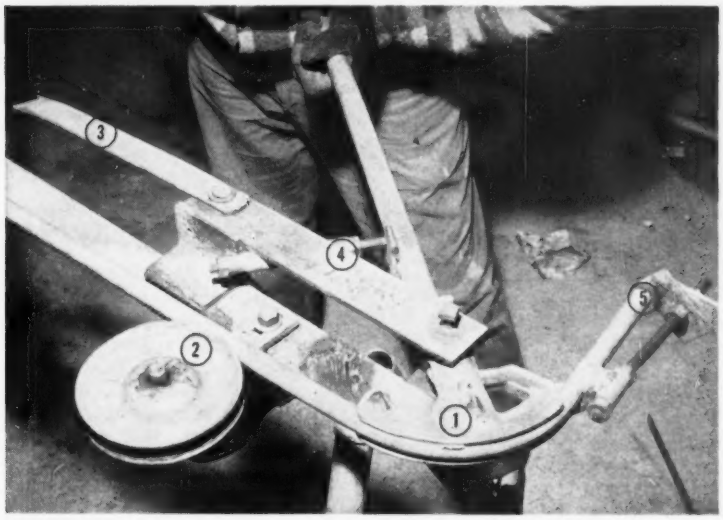
Welded to the bending clamp at one end of the bending shoe is an adjustable threaded-bolt stop which can be preset for the proper offset height. Attached to the end of this stop is a flat-bar positioning saddle which is used for making 45° double offsets in a section of thin-wall conduit. With tubing stops preset and the flexible arrangement of



45° OFFSET is formed with same settings except that bar-stop (3) is swung into position to halt lever-arm travel at proper point for perfect 45° bend in tubing.



EXTENSION SADDLE on conduit stop is used to position flopped-over conduit for reverse 45° bend in double offsets used for baseboard outlet laterals.



BENDER MECHANISM consists of: (1) pivoted conventional bending tool; (2) tubing retention sheave; (3) swing-out bar stop for 45° offsets; (4) stationary rod stop for 90° bends being formed in this photo; and (5) conduit positioning stop preset to offset height.

BENCH BENDER on conduit horse permits mass-production of EMT offsets in branch-circuit raceways for multi-story apartment building wiring.

EMT BUNDLES of pre-cut and pre-bent lengths are "packaged" at fabrication center, carried to installation deck and spotted to match layout requirements.

lever-arm stops, 90° and 45° offsets can be made interchangeably, if necessary, without making any intermediate measurements or adjustments.

Depending upon work progress, tubing can be cut and bent to meet individual apartment requirements or a complete deck. Fabricated sections are then grouped into bundles for each apartment.

Special Mercury Luminaire for Street Lighting

Hollywood, Calif., the "town that glamour built," has a new look in street lighting, for three miles of sidewalk bordering famed Hollywood Blvd. are now illuminated to a brilliant 10-footcandle level; approximately eight times its former night-time intensity.

Heart of this conversion is a new 2100-watt mercury luminaire containing three 700-watt deluxe white lamps developed specially for this installation. And, to create a color tone complimentary to most complexions and decorative patterns, special filter glass was used in addition to lamp-bulb phosphors. Lamps have lifespan ratings of 10,000 hours, or about 2½ years of service, while luminaires are equipped with additional plug-in receptacles to accommodate special seasonal lighting. When completed, the installation will include over 150 units.

Installation of these new fixtures is one of several civic modernization projects now in progress, a related one being the installation of 15,000 lineal feet of terrazzo sidewalk which will contain the names and symbols of some 1200 stars from the fields of radio, television, recordings and motion pictures.

KNOW YOUR SYMBOLS

This symbol stands for circuit breaker

This symbol stands for QUALITY

BullDog Pushmatic panels

Give maximum "on-the-job" flexibility

Look at all the residential circuit combinations you can wire with the PL12 Pushmatic Electri-Center!

- 6-circuit electric heat (220-volt)
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- 100-amp main and 20
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- 100-amp main, range, dryer, water heater and 8

See our "Pushmatic Pocket Guide"* for other panel and circuit combinations.

With all BullDog Electri-Center® panels, you get exceptional residential circuit flexibility. The standard Single Pushmatic® circuit breaker puts a 110-volt lighting circuit in a single panel space . . . the Duplex puts two in a single space . . . and 2-pole Pushmatics, even 100-amp breakers, take but two spaces. Result—Pushmatic breakers and Electri-Center panels answer all your residential circuit requirements . . . *with no callbacks.*

**Send for a copy of the "Pushmatic Pocket Guide." It's free!*

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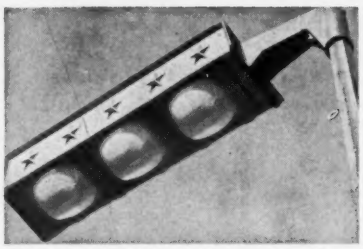
I-T-E CIRCUIT BREAKER COMPANY

BULLDOG ELECTRIC PRODUCTS DIVISION



WALK OF FAME bordering Hollywood Blvd., with names and symbols of 1200 stars from the entertainment world displayed along three miles of terrazo sidewalk, will be lighted to intensity of 10 fc by special 3-lamp mercury-vapor luminaires created specially for this purpose. To obtain most flattering color rendition, filter glass was specified in addition to special lamp phosphors.

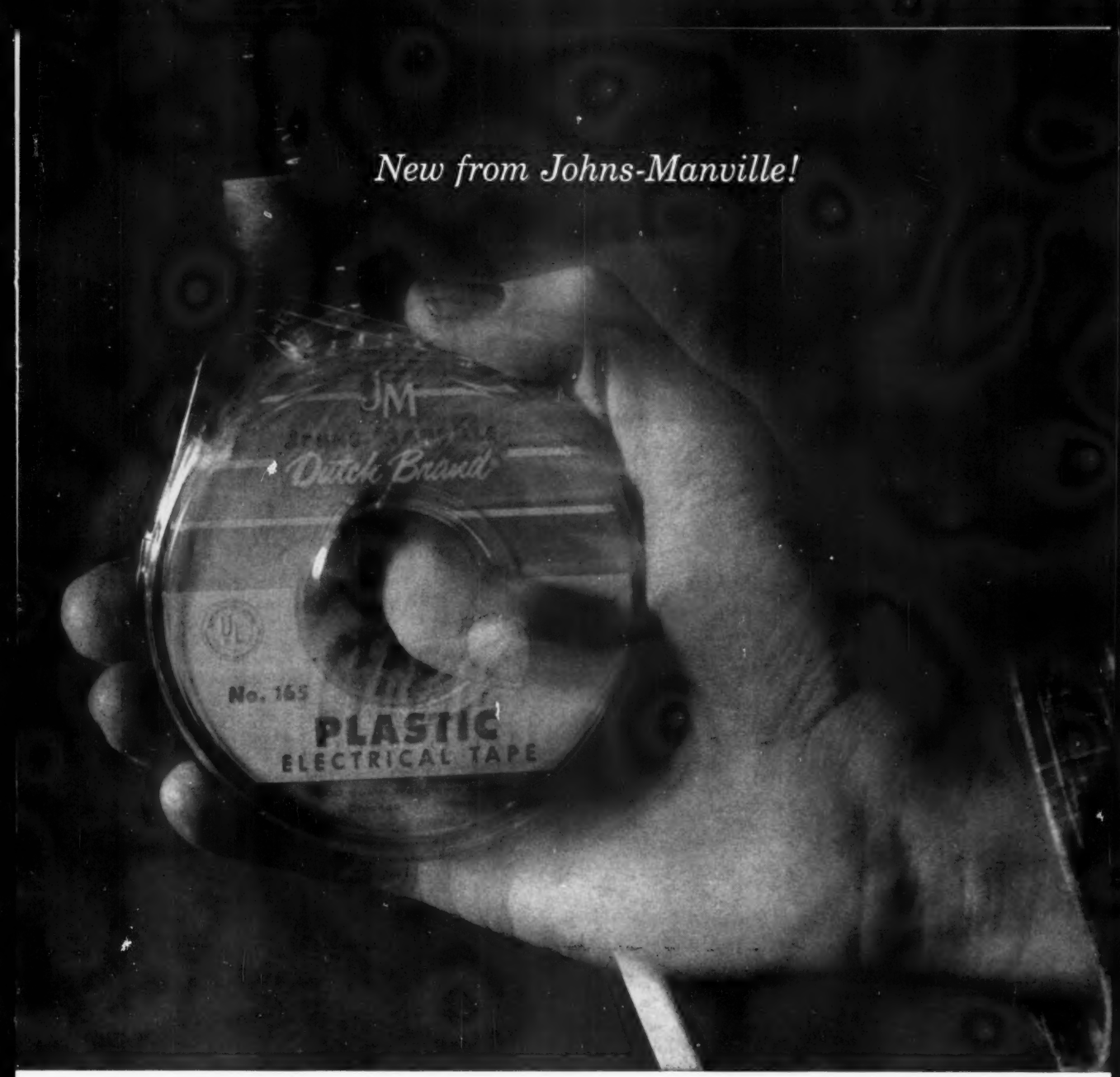
Electrical contractor installing this lighting system was Newbery Electric of Los Angeles. Luminaires and lamps were designed by Westinghouse, while Pacific Union Metal supplied luminaire supports and pole extensions.

Improved PF Capacitor Design Offers Advantages

Recent improvements in the design of low-voltage capacitors offer added advantages to installers and users of power-factor correction equipment. As a result, power-factor correction can be achieved effectively and economically in many additional applications.

In a report by G. R. Menkart, General Electric Co., pertinent considerations concerning low-voltage capacitor installations were discussed. It was brought out that in many instances, low-voltage capacitors installed at the loads can provide a practical and efficient installation. Individual circumstances, of course, dictate the most desirable location and type of capacitor installation. However, when located near or at the load, individual units can be installed easily without special tools or handling equipment. In addition, it is usually possible to install individual capacitors without disrupting electric service to other loads. And because these capacitors (including dustproof and weatherproof types) are easily mounted and removed, their use facilitates redistribution of power-factor correction when plant load conditions change.

It was pointed out that when selecting capacitors, their voltage



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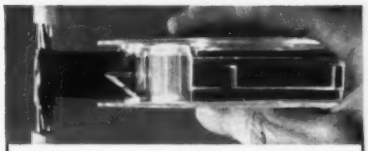
THIS BRAND-NEW DISPENSER makes handling plastic electrical tape a revelation! Far safer, too, because the cutter is permanently shielded . . . can't snag hands or clothes.

From beginning to end, you'll save time and trouble with J-M *Dutch Brand* Plastic Electrical Tape in this great new dispenser. And you'll like *all ten* of the big advantages shown on the right.

But, see for yourself! Get all the facts on Dutch Brand® Plastic Electrical Tape in the handy new dispenser from your J-M Dutch Brand Distributor. Or write to Dutch Brand Division, Johns-Manville, Box 359, New York 16, N. Y. In Canada: Port Credit, Ont. Cable: Johnmanvil.



TEN IMPORTANT ADVANTAGES!

1. *Permanently shielded cutter!* 2. *No moving parts to snag hands, clothes!* 3. *Can't dull or clog!* 4. *"Tape-and-tear" with one hand!* 5. *Special "grip-strip" for faster starting!* 6. *Full 66' of finest plastic electrical tape made!* 7. *Preloaded . . . ready to go!* 8. *Protects tape against dirt, grease!* 9. *Big center hole for easy handling!* 10. COSTS NO MORE THAN TAPE ALONE!

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ratings should be as close as possible to the voltage that will be encountered in service. Capacitors continuously operated at more than 110% of their rated voltage sacrifice life. On the other hand, capacitors operated at less than rated voltages sacrifice considerable kvar output.

Because the capacitor kvar output is proportional to the applied voltage, the most efficient operation will be obtained at the unit's rated voltage. For example, when two capacitors having the same kvar rating, but with one rated 460 volts and the other 480 volts, are energized on a 480-volt supply, the kvar output of the one rated 460 volts will be 8% less than the one rated at 480 volts. This kvar output ratio holds true for 230 vs 240 volts and 575 vs 600 volts.

It was stated that the improved capacitors, besides having optimum voltage-level considerations incorporated into their design, are also smaller and lighter and permit higher kvar output. The kvar output ratings have been increased to include a 25-kvar unit at 460 and 575 volts. This means that, for a capacitor-bank installation, the number of units to be installed and interconnected is reduced, resulting in less installation time and costs. For example, where five 20-kvar units were previously required to make up a 100-kvar bank, the same rating can be achieved by installing four 25-kvar units.

Other new advantages pointed out include integral high-capacity fuses and improved interconnection design.

CHARLES H. HAYES president, and Henry F. Hopkins, vice president of The Electrical Estimators, Inc., Los Angeles, check take-off sheets against experience-based "rules of thumb" before totalizing basic material costs. Possibilities for error are minimized by use of special forms, efficient take-off procedures and excellent working conditions in their plan room.

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whether the job's drilling, sanding, sawing,


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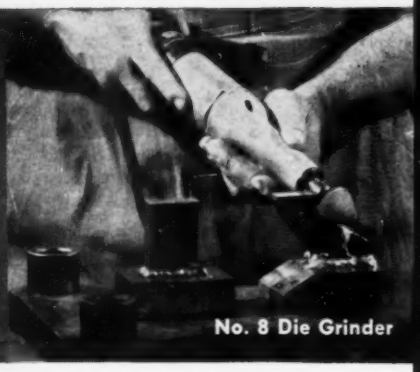
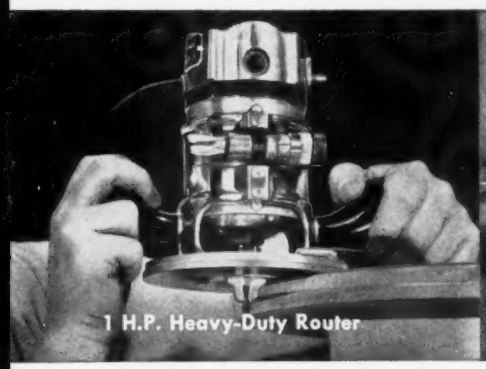

No. 8 Die Grinder

or any other tool job, you'll find that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MOTOR SHOPS

Perforated Angles for Framing

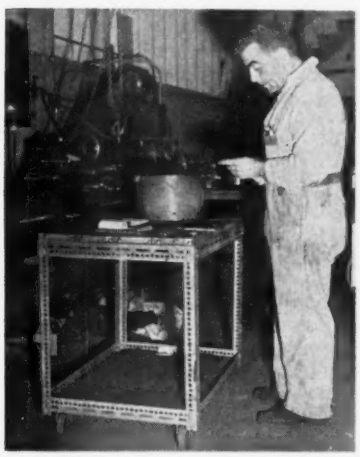
Mobile work benches, racks and storage shelves formed from perforated angles and framing members are used extensively by Atlas Electric and Engineering Co., San Francisco, to facilitate movement of equipment and motors from one area to another, and to permit fast and easy reallocation of floorspace when shop rearrangement or normal housekeeping routines dictate.

Fabricated in the shop from slotted metal angles which are obtainable with ready-to-assemble factory-accurate right-angle bends, dimension marks and perforations, these various structures may be constructed with hand tools.

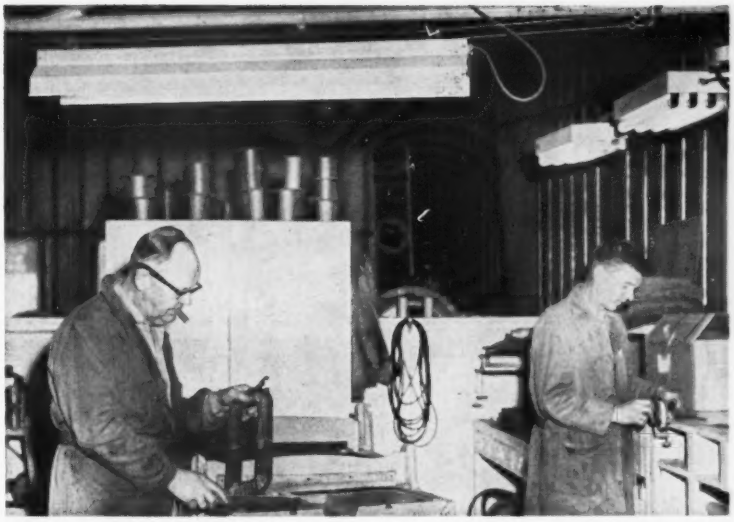
All that is necessary for construction is a hacksaw for cutting angles to prescribed dimensions, assortments of hex-head bolts and nuts, a wrench for tightening same, plus factory-assembled casters.

Subsequent disassembly of these units for shipping or for reformation into other forms is unlikely, although this could be accomplished if need be, merely by removing bolts and collapsing assemblies for compact storage or movement.

As noted in the accompanying photo, a sturdy work surface can be formed from wooden planks. Or, if surfaces with heat-, skid-, or impact-resistant properties are desired, surfaces can be additionally covered with metal, abrasive or rubber-sheets.



HACKSAW and pliers, plus assortments of hex-head bolts and nuts are the simple tools and mediums required for assembling pre-punched angles into useful tables, racks and shelves for shop use.



FLUORESCENT FIXTURES, supported by messenger wires which in turn are secured to swinging booms, can be placed at will over any desired work area within the limits of the boom arc.

Adjustable Lighting for Motor Shops

Good lighting is a feature of Ed Kurze's motor repair shop in San Jose. And, as indicated by the accompanying photo, many of the industrial fixtures are made adjustable by (1) equipping them with canopy brackets that slide freely along supporting messenger wires, and (2) attaching the messenger wires to brackets secured to the underside of the swinging booms which are made of welded conduit sections and are pivoted at wall lines.

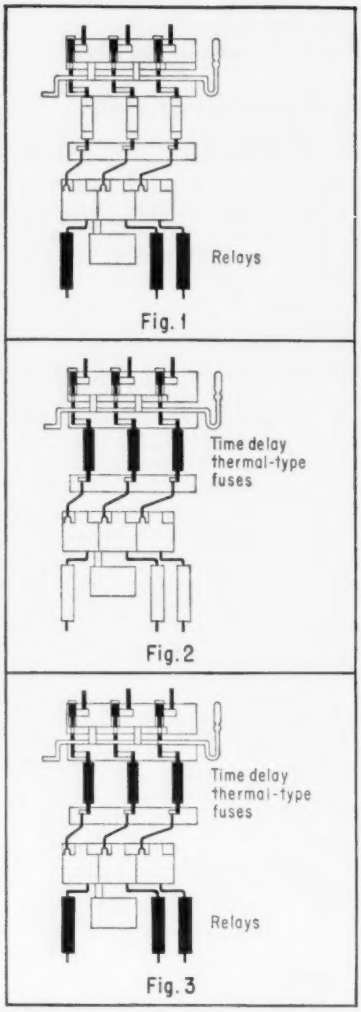
Connection of fixtures to wall-mounted receptacle boxes is via long, flexible neoprene-jacketed cords. And, since booms can be swung 180 degrees, since fixtures can be moved to any desired position along the length of the lower boom arm, and since movement of the units is unhampered by non-flexible circuit connections, the various lighting units can be positioned at will over any specific work area within the arc of any specific boom. Since the shop is equipped with numerous such installations in addition to close spacing of 4-lamp fluorescent banks above wall-placed work benches, Kurze employees have the benefit of ample lighting wherever they happen to be working at the moment. Such an installation provides an effective, flexible lighting system.

Protection for 3-Phase Motors

Motor failures are costly both in dollars and in interrupted work schedules. Therefore it is advisable to install protective devices designed to safeguard motors against overloading. This is common sense, because overloading forces motors to work harder than their capabilities, causing excessive current to flow through windings, resulting in temperature of windings rising unduly and, eventually, contributing to the failure of insulation.

Motor failure can also occur due to unbalanced motor currents caused by unequal internal motor windings, or from having too much single-phase equipment connected on the same power circuit. Motor burn-outs can also result from a break in one of the three wires carrying power to a 3-phase motor, and this break can be located either within the motor-owner's distribution system or outside of his premises in the lines of the utility supplying the power.

These several facts are pointed out in pamphlet form to customers of the San Jose Armature Works, San Jose, Calif. Customers are further advised that the risk of burn-outs can be lessened by installing protective devices of recommended types in recommended numbers and locations. This basic



PROTECTION for 3-phase motors against burn-out possibilities may be obtained with heat-activated overload relays, time-delay thermal-type fuses, or combination thereof, as indicated in these sketches.

instruction sheet likewise informs them that some practices formerly considered adequate for complete protection are not necessarily adequate under all conditions; such as the former practice of placing standard-type fuses in the three leads to a 3-phase motor, with heat-activated relays additionally located in two of the three legs.

Present thinking, however, recognizes the facts that (1) excessive current can flow through the one wire without the relay, and that (2) standard fuses designed to withstand severe short-circuit currents are too large and too insensitive to respond to less-severe overloads.

The solution, customers are informed, is to provide current overload protection in all three leads,

Now! Any old electric hammer is worth $60 or more trade-in

on a New Skil ROTO-HAMMER

...the hammer that revolutionized masonry drilling

Your Skil distributor is ready to give you a whopping big trade-in allowance on a new Skil Roto-Hammer—*the fastest, easiest, lowest cost way to drill masonry holes!* You'll actually receive $60 or more worth of Skil Hammer accessories as your trade-in for any old electric hammer, regardless of make, model or condition.

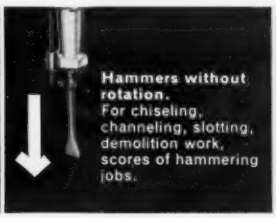
Two Roto-Hammer models are available —new, improved Model 726 (drills masonry holes from 11/16″ to 1½″ diameter); Model 736 (drills masonry holes from ½″ to 3½″ dia.).

See your Skil distributor NOW for complete information. *But hurry! This sensational trade-in offer is for a limited time only!* Look under "Tools—Electric" in the Yellow Pages. Or write: Skil Corporation, Dept. 130H, 5033 Elston Avenue, Chicago 30, Illinois.

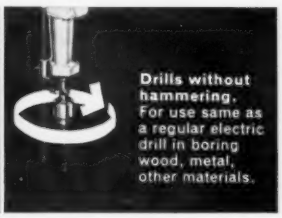
SKIL POWER TOOLS

Only Skil Roto-Hammers have 3-way action

Hammers with automatic power rotation. For fastest, lowest cost masonry drilling without tedious hand rotation of star drills.



Hammers without rotation. For chiseling, channeling, slotting, demolition work, scores of hammering jobs.



Drills without hammering. For use same as a regular electric drill in boring wood, metal, other materials.

...and only Skil Roto-Hammers use 4 types of percussion-rotary bits...over 150 accessories in all for unequalled versatility!

such protection achieved in two ways as indicated by accompanying sketches. For example, heat-activated overload relays can be installed on all three motor leads (Fig. 1), or time-delay thermal-type fuses can be used (Fig. 2), or these two procedures may be combined as shown in Fig. 3, which features dual protection.

It is noted that, in the West where irrigation pumping is fairly extensive, pumping panels made during the past few years have spaces provided for three relays, that the cost of a third relay is small, and that the installation is simple. On standard motor starters and older pumping panels, installation of a third relay may require an additional reset mechanism and possibly a larger enclosure—the cost of which, while not minor, being considerably less than replacement or repair of a burnt-out motor. The pamphlet suggests that time-delay thermal-type fuses offer the simplest and most economical solution for protecting standard industrial motor starters employing fuses, because they compare in cost favorably with standard-type fuses, and they provide both overload and short-circuit protection in a single device.

In conclusion, customers of this repair shop are advised that motor efficiencies and lifespans can be safeguarded by:

—placing motors in cool, well-ventilated surroundings to prevent excessive temperatures;

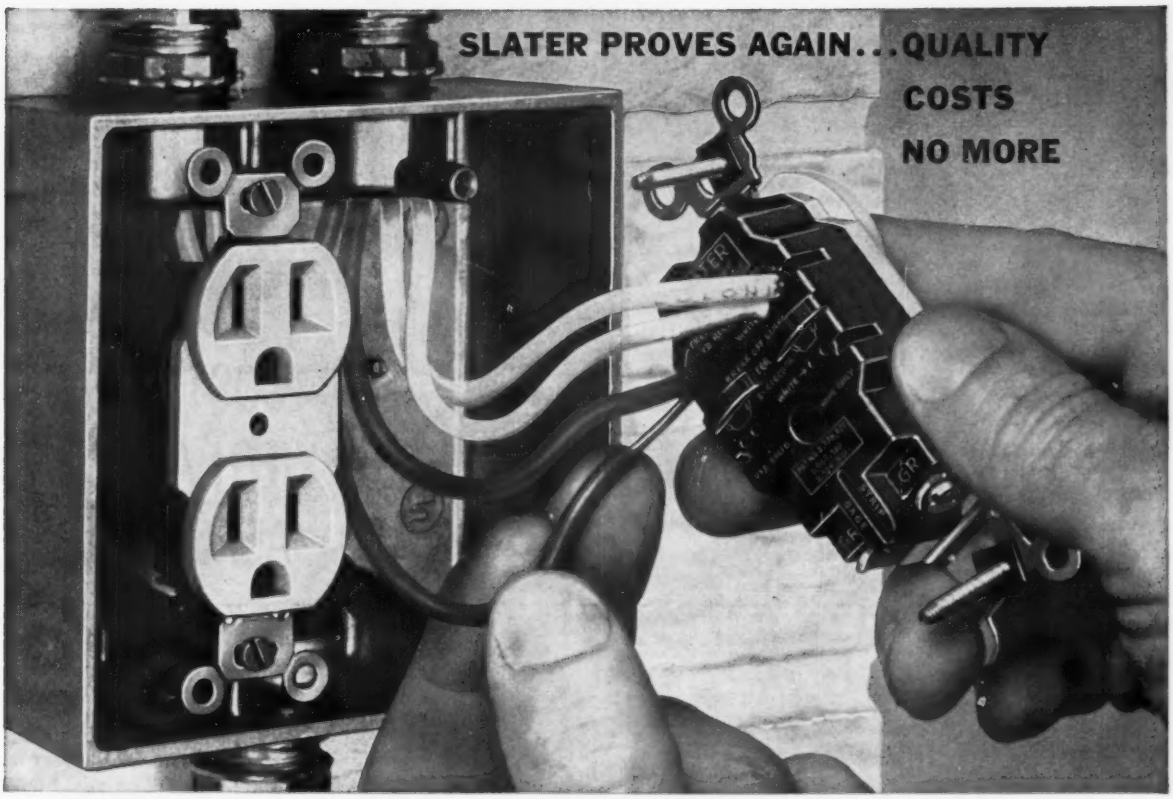
—using correct lubricants in recommended amounts, neither over- or under-greasing, and avoiding filling oil holes to the point where they drip;

—checking to see that voltage and frequency of the power supply coincide with motor characteristics;

—installing proper wiring and fuses, making bolt connections tight and checking starter contacts and fuse clips for cleanliness and good contact surfaces; and

—guarding against action of such foreign materials as water, acids, metal dust or abrasives reaching motor windings or clogging ventilation openings.

Finally, customers are warned that although motors are designed to operate with minimum attention, they cannot be completely ignored, and that periodic inspections and reasonable care will pay dividends in the form of improved, prolonged service. In addition, preventive maintenance will reduce downtime of vital equipment.



NEW 15 AMP. GROUNDING OUTLET

❶

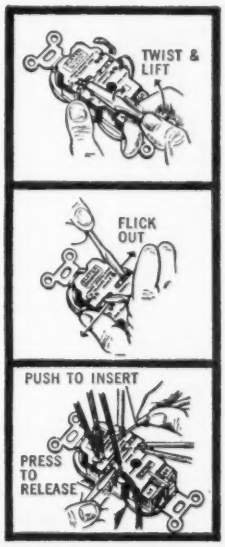
When 2-Circuit wiring is required, insert blade of screwdriver in slot under cap. Then twist and lift, snapping off caps to expose break-off links as shown.

❷

Then, using screwdriver, "flick" out brass break-off links as indicated. All four links must be removed in order to form separate circuits.

❸

This special "Speedwire" grounding outlet will take up to eight No. 12 or No. 14 solid wires... it splices internally, thus eliminating the need for external splicing.



INSTALLS FASTER... SPLICES INTERNALLY

The Slater Model 880 15-Amp Duplex Grounding Outlet provides outstanding saving in installation time. Patented Speed Wire feature accommodates up to eight #12 or #14 wire—permits internal splicing and completely eliminates the need for wire nuts on perimeter wiring jobs. Gives greater flexibility on switch legs, too.

In addition, the 880 series feature patented side release, double wipe contacts, *easy break-off links for separate circuits*, captive mounting screws and most important—sensible price!

Slater ELECTRIC INC.

Glen Cove, L.I., New York

In Canada: E & H Sales Company, 9735 Jeanne Mance St., Montreal 12, P.Q.

Want more details on these and over 600 other quality wiring devices? Mail the coupon today.

Slater Electric Inc., Glen Cove, New York
Dept. CH

Gentlemen:
Please send me a copy of the Ready Reference Catalog of wiring devices.

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Anaconda's compact, self-supporting factory pre-assembled aerial cable is installed as a *single unit*. No field assembly is required—and no lashing operation. In plants where the maze of pipes and other underground structures often make installation of ducts or buried cable costly or difficult, this cable solves the problem.

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You can attach Anaconda aerial cable directly to a pole or building-attached bracket.

Type AB butyl insulation and Neoprene jacket affords resistance to moisture and heat. For the full story, call the Man from Anaconda today. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York; Department EFL-1-ECM. 61262C

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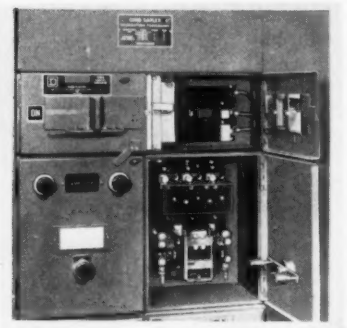
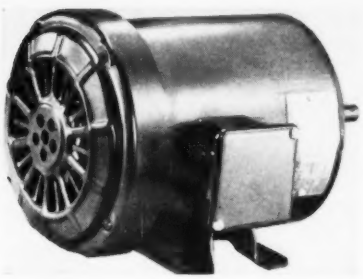
Product News



Panelboards (1)

It is now possible to mount circuit breakers as well as fusible switches and motor starters in QMB panelboards. Circuit breakers are available in single and twin units, in ratings from 125-255 and 15-100 amps respectively. Each unit is furnished in an individual steel enclosure with dead-front construction. For extra safety, plug-in units—both switches and circuit breakers—mount directly above starters, permitting interlocking. They accommodate reversing or non-reversing starters, Sizes 0 through 4; plug-in circuit breakers through 225 amps; plug-in switches through 200 amps (600 amps bolted). Bulletin SD-80 is available.

Square D Company, Mercer Road, Lexington, Ky.



Motors (2)

A complete line of totally enclosed, fan-cooled motors has been added to this line of Form G fractional hp motors. Motor line is ideal for industrial applications where dust or dirt is prevalent. Cooling is accomplished by an outboard fan directing an air stream over motor. Totally enclosed fan cooled motors with a resilient base and others with NEMA 56C end mounting are included in the line. Available in ratings from $\frac{1}{3}$ to 1 hp in NEMA-56 frame size, this line meets NEMA standards in capacitor-start and polyphase single-speed and split-phase single and 2-speed designs. All are rated continuous duty, 55 C rise.

General Electric Co., Schenectady 5, N. Y.

Bender (3)

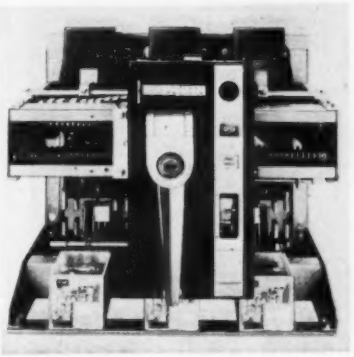
A new bender, called the "Little Kicker," No. 1810, makes offset bends in $\frac{1}{2}$ in. EMT for entering switch and junction boxes, fuse boxes and other outlets. Both bends of offset are formed simultaneously by pressing down on handle. Bender weighs $5\frac{1}{2}$ lbs.

Greenlee Tool Co., Rockford, Ill.

Instrument (4)

Immediate detection of accidental grounds on power lines is provided by the Brunt Ground detector and alarm. When instrument is wired to a power system, 3-phase indicator lamps on face glow with equal intensity. As a ground occurs, one of the lamps dims or goes out, indicating on which phase the ground has occurred. Simultaneously a red warning lamp flashes steadily and a relay actuates an audible signal (bell or horn) which should be connected to the instrument. Warning flash and audible signal continue until a reset button is pushed; red lamp glows until ground is cleared.

Parr Manufacturing Corp., 40 Austin St., Newark, N. J.



CB Switchgear (5)

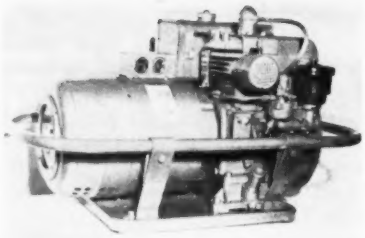
A new design of power circuit breaker switchgear has been designed to meet the more severe requirements of modern electrical systems. Major feature is uprating of individual breaker sizes. Previous standard sizes for units of this type were 225-, 600-, 1600-, 3000- and 4000-amp frame sizes. With the new line, ratings of the first three sizes have been raised to 400, 800 and 2000 amps. A second feature is substantial increase in short-circuit interrupting ratings, permitting selective coordination schemes at no premium. The three smaller breakers have IC ratings of 50,000 asymmetrical rms amperes and the larger units are rated for 100,000 amps. New design covers: stored-energy mechanism, ready change in setting of adjustable tripping device, and coil structure. The line also includes a hoist integral with the switchgear housing to permit ready exchange of CB units by a single maintenance man.

Federal Pacific Electric Company, 50 Paris St., Newark 1, N. J.

Incandescent Light (6)

A new Westinghouse-By-Frink square-frame incandescent downlight is now available. It can be supplied in sizes of 100, 150 or 300 watts, prewired or unwired, and with frame of white enamel, aluminum, or bronze. All surfaces except for frames are covered with a white baked-enamel finish. Available shielding includes an Alba-lite 55 lens for even illumination with a wide spread, a Fresnel lens for minimum glare with a medium spread, and a dished opal shield for both down and ceiling illumination. Listed by UL.

Frink Corporation, 211-63d St., Brooklyn 20, N. Y.



Generators **(7)**

A versatile new series of portable engine-generators is available in sizes of 1000, 2000, 3000 and 4000 watts, ac, 3600 rpm. Features include Briggs & Stratton engines, pull starter, protective carrying frame, rubber mounts and handy receptacles, with optional wheel dollies and housing also available. New 1800-rpm series also available with sizes starting at 750 watts and up for electric, remote, demand starting and automatic transfer arrangements. Brochure is available.

Katolight Corporation, Box 891, *Mankato, Minn.*

Troffers **(8)**

New Series R31 open-design recessed aluminum troffers have reflectors and louver assemblies finished by the Alzak process which provides a diffuse surface protected by a dense, hard coating of aluminum oxide with a reflectance of more than 75%. Parabolic-contoured aluminum blades increase lumens in useful areas. Housings are constructed of cold-rolled steel, die-formed in 4- and 8-ft lengths. Housings are sprayed and baked with 86% reflectance white enamel. Knockouts allow continuous wiring of end-to-end mounted fixtures. Catalog sheet is available.

Litecraft Manufacturing Corp., 100 *Dayton Ave., Passaic, N. J.*

Enclosures **(9)**

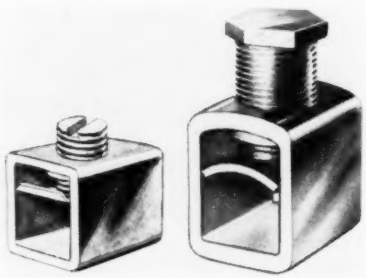
NEMA 12 panel enclosures for mounting the new externally operated disconnect switches are now available. A front mounting disconnect means such as the new Square D Class 9421 or Westinghouse Class 99-120 provides a safety device for control enclosures. When installed in enclosure, handle is never separated from disconnect mechanism and can be locked in "off" position when door is open or closed. Door is positively latched with a 2- or 3-point operating mechanism, but a "bypass" allows authorized inspection or service in "on" position. Oil- and dust-tight enclosures are formed from 12- or 14-gauge steel with welded seams and gasketed door. Box sizes run from 20 by 20 in. up to 60 by 37 in. in varying depths.

Hoffman Engineering Corp., Anoka, Minn.

Magnet Wire **(10)**

A new ML film-coated magnet wire which affords continuous high-temperature operation up to 250C, and resists heat shock up to 425C has been introduced. The heat stability of the new ML makes it adaptable to high-temperature applications, also provides for reduction in electric motor sizes. ML has high chemical resistance making it suitable for most types of encapsulated windings. It is available in all sizes of round, square and rectangular magnet wires. Film addition is single, heavy, triple, or quadruple, conforming with NEMA specifications.

Anaconda Wire and Cable Co., 25 *Broadway, New York* 4, *N. Y.*



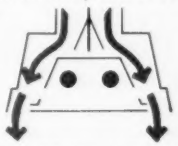
Connectors **(11)**

New pressure wire connectors for aluminum or copper conductors. All of the 100-, 125-, 150- and 200-amp fusible and circuit-breaker service entrance devices are equipped with these new connectors. Features are: made of plated copper; traveling pressure plate is attached to screw; screw is in raised position when installed on devices; listed by UL; connectors are being installed on both the line side and neutral position.

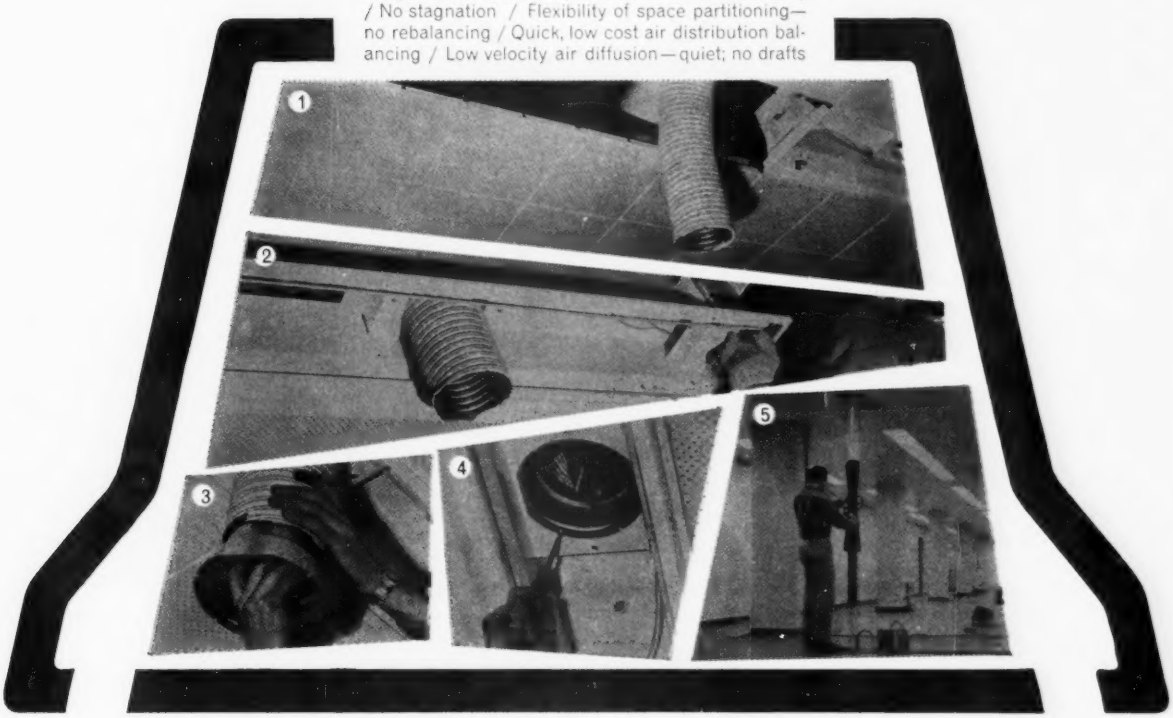
Wadsworth Electric Mfg. Co., Inc., Covington, Ky.

LOWEST TOTAL COST

The Multi-Vent system's unique design and engineering enables you to gain the advantages of combining light and air distribution at lowest cost. This applies to initial installation, operation, and maintenance costs, whether the totals be compared with separate systems for providing lighting and air conditioning, or for other combination systems. Take maintenance costs, for instance—by diffusing the air straight down at low velocity, *Multi-Vent prevents ceiling or wall smudging* and thereby *reduces cleaning and redecorating costs*. And, ... Here's A Union Approved Procedure that Helps Keep *Installation* Costs Low. **1.** Flexible tubing dropped through fixture opening in completed ceiling. **2.** Troffer installed—tubing extending through 5" knockout **3.** Air valve assembly conveniently attached to the tubing from below **4.** Completed ceiling without access through ceiling **5.** Exclusive "Venturi" simplifies accurate balancing.



THE MULTI-VENT SYSTEM GIVES YOU THESE OTHER IMPORTANT BENEFITS More light output / Longer ballast life / Superior room air conditioning / No stagnation / Flexibility of space partitioning—no rebalancing / Quick, low cost air distribution balancing / Low velocity air diffusion—quiet; no drafts



THE MULTI-VENT SYSTEM OF LIGHTING AND AIR DIFFUSION

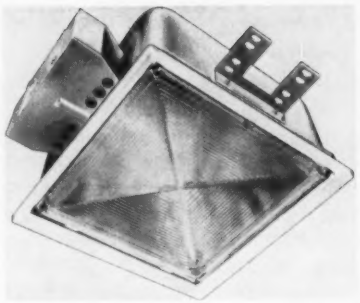
THIS SYSTEM IS AVAILABLE FROM THE FOLLOWING MANUFACTURERS:

***COLUMBIA**, Columbia Lighting, Spokane, Washington*

***MILLER**, The Miller Co., Meriden, Connecticut*

***PYLE-NATIONAL**, The Pyle-National Company, 1334 N. Kostner Avenue, Chicago 51, Illinois*

***SYLVANIA**, Sylvania Electric Products, Inc., Wheeling, West Virginia*



Lighting Fixture (12)

A recessed lighting fixture, called "tamper-proof Uni-Frame," is suitable for indoor handball courts. It uses a concave lens which is unbreakable and unchippable. Uni-Frame is available in two sizes: a 10-in. fixture for a 100- or 150-watt lamp, and a 12-in. fixture for a 200- or 300-watt lamp. The 10-in., with frame, fits a standard 12-in. tile opening. Frame is available in a baked white or natural aluminum finish.

Day-Brite Lighting, Inc., 6260 *N. Broadway, St. Louis* 15, *Mo.*

Conduit (13)

"Color-coded" Sherarduct conduit, with MVC-1 coating, has been introduced. This is a rigid steel conduit, available in all sizes in a choice of five colors, with matching elbows and couplings. Product was developed to provide color-coding of conduit runs in factories and other industrial locations, such as in distinguishing runs carrying electrical lines from those carrying telephone or intercom lines.

National Electric Div., H. K. Porter Co., Porter Bldg., Pittsburgh, Pa.

Receptacle and Plug (14)

Type EHR receptable and Type EHP plug are designed to meet the requirements of NFPA Bulletin 56. The explosion-proof receptacle, used in combination with a washable, watertight plug, combines the hospital feature of asepsis with the extra protection of a grounded, keyed and flame-tight electrical receptacle. The EHP plug is especially keyed so that it is the only plug that will actuate the EHR receptacle, but the EHP plug can also be used in standard non-explosion-proof Hubbellock receptacles. Its 3-wire construction offers safety of equipment grounding.

Crouse-Hinds Company, Syracuse 1, *N. Y.*

Line Protection (15)

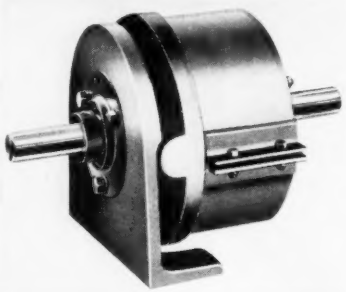
Protection for rotating ac machines against line surges caused by switching, faults, or lightning, using a factory preassembled protection device (Surgepak), has been announced. Protective units, custom designed for each application, are attached and wired into the circuit of rotating ac machines by either machine manufacturer or user. Ratings are available for system voltages from 2400 to 13,800 volts. Device is equipped for a 3-phase installation, one lightning arrester and one capacitor tied in parallel to ground on each phase, with isolated buses and common ground connection.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh* 30, *Pa.*

Starter (16)

Multiple-step interlocking in door and switch design plus visible-blade disconnect feature in new combination starter for industrial applications. Designed to meet NEMA-12, industrial, and NEMA-5, dust-tight, standards, the starter is available with size 0, 1 or 2 contactors and 30- or 60-amp disconnects. Additional optionals offered include third-line overload protection, dual control-circuit fusing, and extra transformer capacity.

Clark Controller Company, 1146 *East* 152*d St., Cleveland* 10, *Ohio*



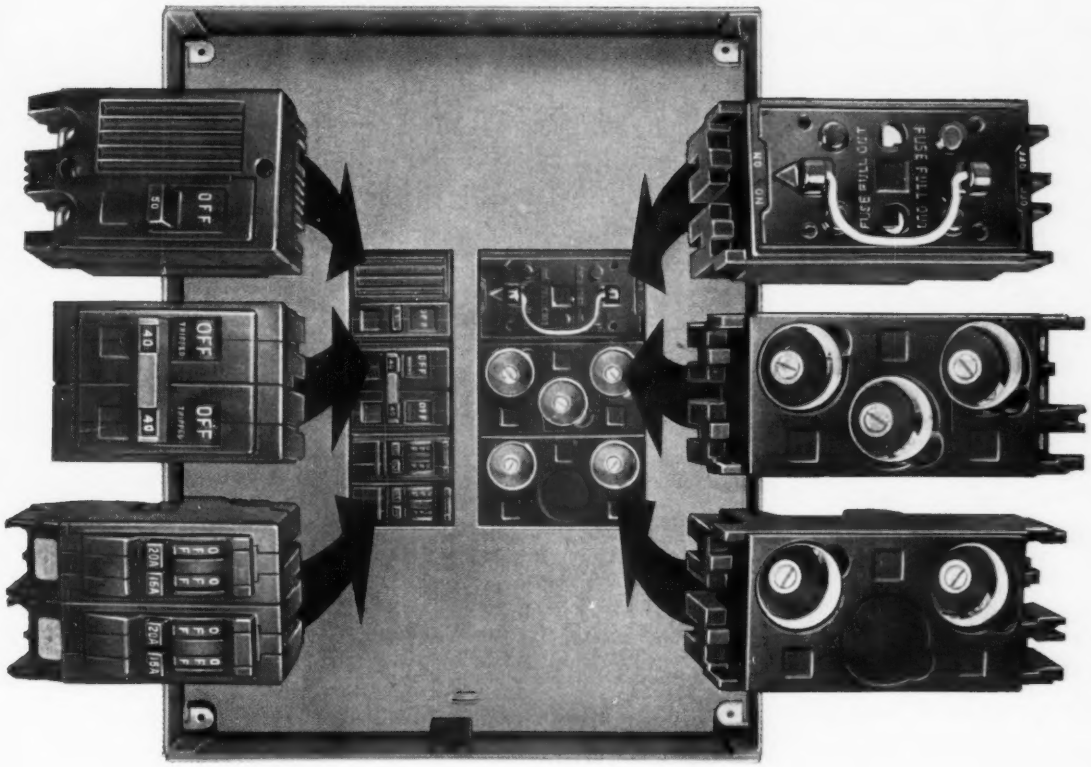
Brake (17)

New 55,200 series of disc brake units has been introduced. They offer brake users a floor mounted, through-shaft brake with its own ball bearing mounted shaft. Intended primarily for applications where it is necessary to drive through brake, this model minimizes alignment problems. The ac operated brakes are available in torque ratings of 1½, 3, 6, 9, 10 and 15 lbs ft.

Stearns Electric Corp., 120 *N. Broadway, Milwaukee* 2, *Wis.*

NEW BREAKER/FUSE PANEL

Plug in breakers and fuses,
mount surface or flush
all with one basic box

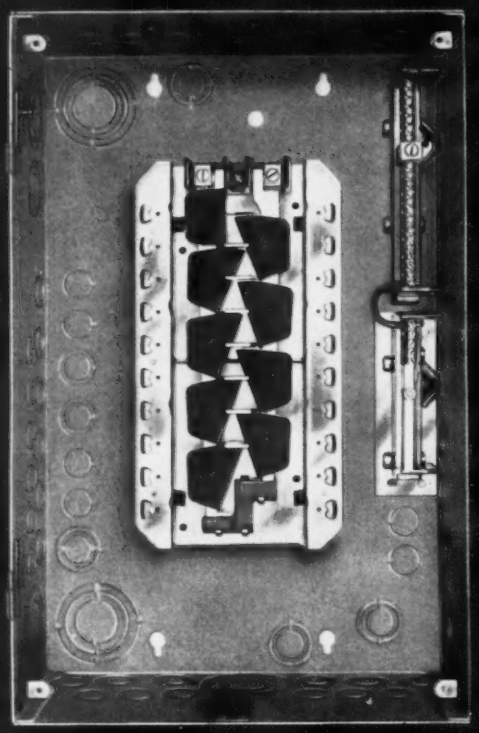


Now General Electric gives you the widest choice in service entrance equipment: "TWIN*" circuit breaker load centers... fuse puller panels and the new 4-in-1* Breaker/Fuse Panels.

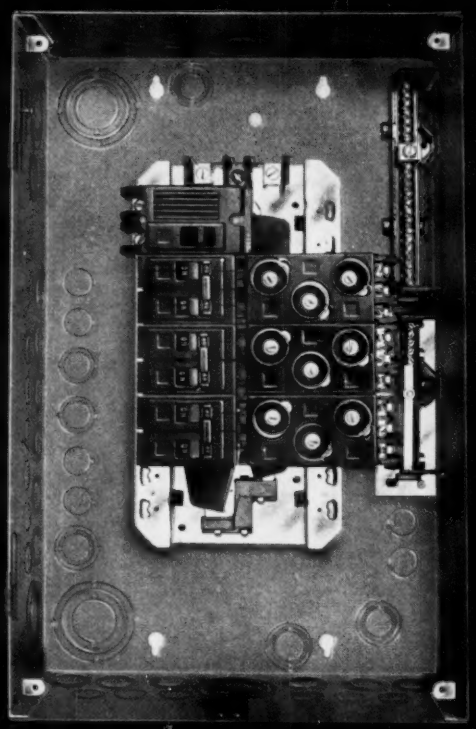
*Trade Mark of General Electric Company.

GENERAL ELECTRIC

SELECT ONE PANEL: PLUG IN



Typical Breaker/Fuse Panel . . . Cat. No. TP1612, shipped complete with box, front, interior; accepts *both* breakers and new G-E plug-in Fuse Blocks. Shown at right are three ways to assemble this panel.



Mix Breakers and Fuses . . . Cat. No. TP1612 with back-fed 100-amp main breaker, three 2-pole TQL breakers, plus nine plug fuses—all in the same box. Only new G-E Breaker/Fuse Panels offer versatility like this!

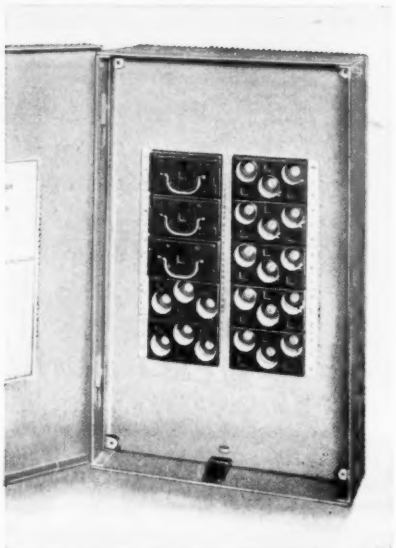
COMBINATION ENCLOSURES - MOUNT EITHER SURFACE OR FLUSH

New Flush Frame Locks Around Box, Hides Rough Plaster, Assures Neat Job.

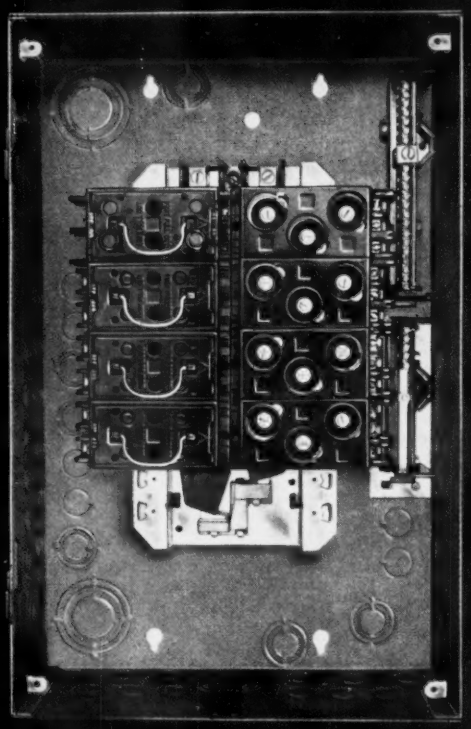
Here's dual mounting versatility: For flush installations, frame locks tight around box. Stud mounting ears automatically position box for ½-inch drywall — save time and labor . . . Nails quickly to studs.

For surface jobs, simply discard flush frame. It's as simple as that!

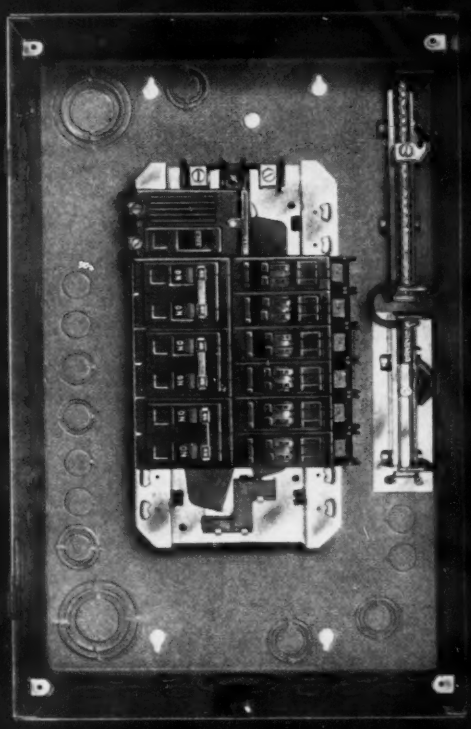
Complete Line 100, 125, 150, 200 amperes, 12 to 40 circuits. Main-lugs-only, split bus and main disconnect models cover full range of applications.



BREAKERS, FUSES...OR BOTH!



All Fusible . . . In the same TP1612 panel another choice is one 60-amp, three 30-amp pullers, plus 12 plug fuses. You plug in new G-E fuse blocks just like breakers — this is only one of many combinations possible.



All Breakers . . . Another way to wire the TP1612: plug in 100-amp breaker (connect line wires to breaker load terminals for backfed main), plus three 2-pole TQL's and 6 "TWIN" breakers, providing 12 lighting circuits.

A BOLD NEW APPROACH TO VERSATILITY...

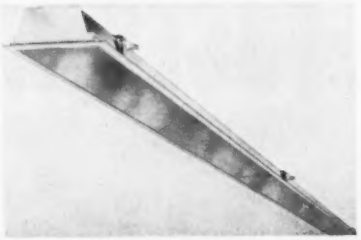
Basic 4-in-1 Idea: With a single catalog number you order a combination flush-surface panel which accepts plug-in breakers, fuse blocks or both!

Wide Choice of Plug-in Units: Breaker/Fuse Panels accept any combination of these plug-in units . . .

- 30- and 60-amp fuse pullers (horsepower rated)
- 2- and 3-circuit plug fuse blocks
- 2-pole circuit breakers, 10 to 100 amperes
- Single-pole TQL and "TWIN" circuit breakers

Bonus Installation Time-Savers: Snap-out front shield; stud mounting ears; reversible box and front; spring-mounted, snap-out interior; removable door; full sequence phasing. All panels are U/L listed and meet NEC non-interchangeability requirements. Available now from your General Electric distributor. Circuit Protective Devices Dept., General Electric Co., Plainville, Conn.

GENERAL ELECTRIC



Lighting Fixtures (18)

A new shallow recessed troffer series of fixtures have an over-all maximum depth of 5 in. Troffers are supported with a new "retractable-adjustable" side lug hanger. Hanger can be adapted to nearly all known ceiling systems. Door frames butt end to end for continuous row installations. Troffer available in 12 and 24 in. widths for rapid start, slimline or high output lamps. Ballasts can be mounted to troffer body or wireway cover. Available with plastic louvers, Holophane lens, Corning lens, Diatex low bright plastic lens, Pristex low brightness lens, ribbed Albalite glass and dished acrylic plastic diffuser.

Mitchell Lighting Division, Compco Corp., 1800 *N. Spaulding Ave., Chicago* 47, *Ill.*

Switches (19)

ASCO® mechanically held automatic transfer switches are now manufactured in 1200-, 1600- and 2000-amp sizes. These 2- and 3-pole switches are listed to 600 volts ac, 250 volts dc. Switches are open type, minimum width, vertical tandem types, particularly suitable for control centers. On single phase or dc, 3-wire systems, normal voltage is supervised across the live lines. Bulletin 906-105 is available.

Automatic Switch Company, Florham Park, N. J.

Gear Motor (20)

A complete line of Radicon gear motors, motorized versions of the Radicon worm gear reducers which feature center distances as low as 1⅛-in., has been introduced. Units incorporate all features of regular Radicon gear reducers. Three series are available: MO, single reduction, fixed base; MHU, helical worm, fixed base; and MA, single reduction, adaptable. Drive motors supplied are standard NEMA flange type, available in a variety of motor enclosures.

Foote Bros. Gear and Machine Corp., 4545 *S. Western Blvd., Chicago* 9, *Ill.*

Speed Variator (21)

Utilizing an integral "pancake" style motor, the new motorized speed variator design insures precise speed setting. It provides variable output speeds with 9:1 and 6:1 ranges. The line is available in sizes from ⅓ to 15 hp. Motors are ac radial air gap design and conform to NEMA design "B" specifications. Power is transmitted through input shaft to a beveled drive disc in contact with axle-mounted alloy steel drive balls.

Cleveland Worm & Gear Div., Eaton Mfg. Co., 300 *East* 80*th St., Cleveland* 4, *Ohio*

Tool (22)

Designed for use in wiring any type, any length conduit ½ in. through 4 in. I. D., the new Jetmaster combines the separate tools of the Jet line method into one portable unit. New unit does the work of the Jet line gun, cylinder and underground. All necessary fittings, adapters and accessories are included, as well as a 500-ft reel of Poly rope and 25-lb CO2 tank for power supply.

Jet Line Products, Inc., 305 *Foster Ave., Charlotte* 3, *N. C.*

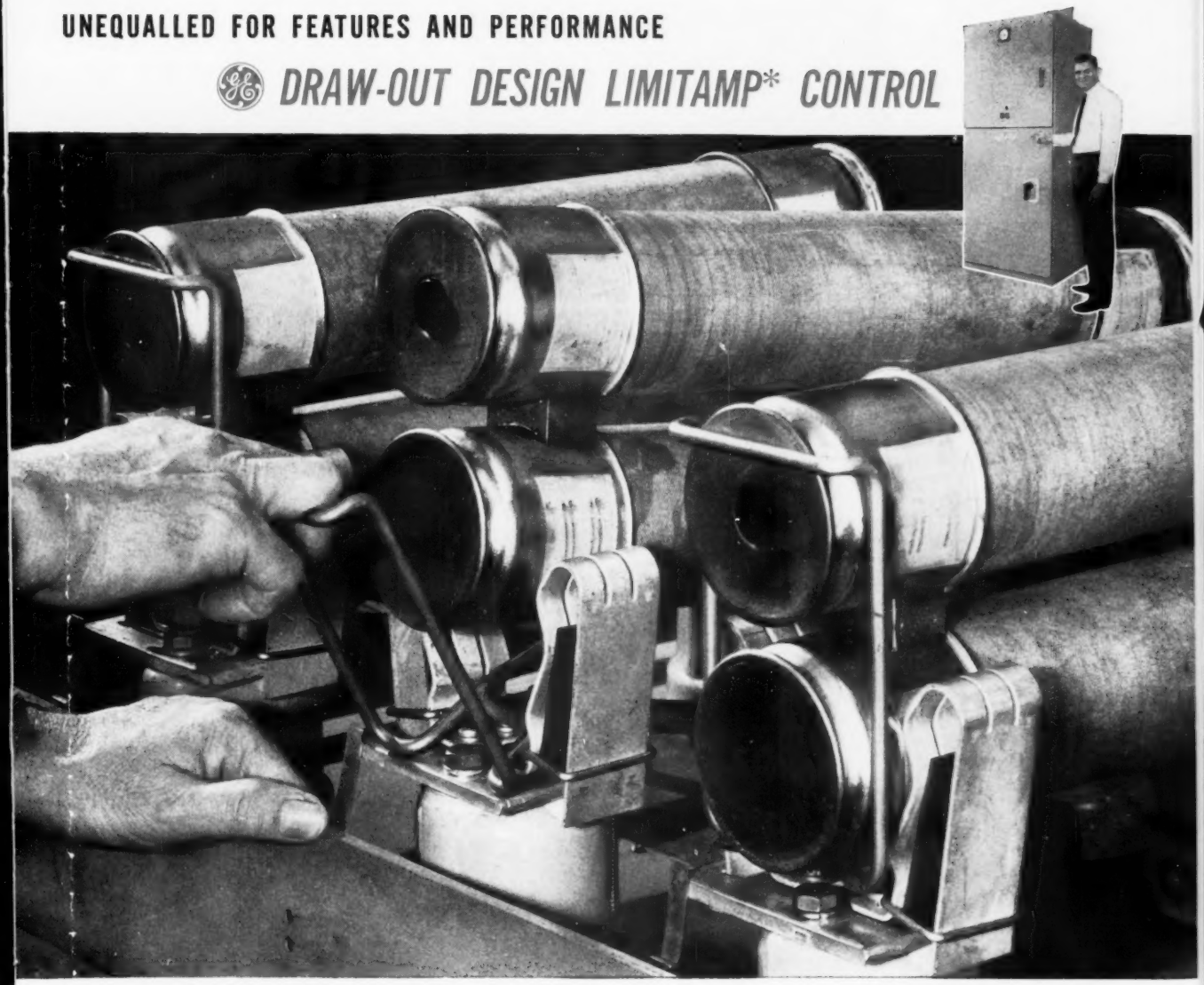
Outlet (23)

A 3-wire clock hanger outlet meets the new code requirements and is listed by UL. It comes complete with wire leads for installation and is available in six metal finishes. Rated at 15 amps, 125 volts, the outlet utilizes a snap-in 3-wire U-ground receptacle recessed in a large cup opening which holds male plug and surplus wire. Hanger prong is an integral part of plate and, together with recessed cup, allows flush mounting. Catalog sheets are available.

Bell Electric Co., 5735 *S. Claremont Ave., Chicago* 36, *Ill.*

UNEQUALLED FOR FEATURES AND PERFORMANCE

DRAW-OUT DESIGN LIMITAMP* CONTROL



INTERRUPTS IN 1/2 CYCLE

...protection when you need it—with Limitamp control

Here is performance you can count on ... to start, stop, and protect your motor under *your* environmental conditions!

General Electric's draw-out Limitamp control, rated 2300- to 4600-volts for a-c motors up to 3000 hp, interrupts in the first ½ cycle. Current is limited in the first ¼ cycle. EJ-2 fuses—the standard of excellence—give you this dependable short-circuit protection.

Performance of the draw-out contactor is outstanding under all load conditions—from small motors running light to large motors at "locked rotor." A new blow-out structure and an improved arc chute with superior extinguishing action provides this improved performance. What's more, the new Limitamp contactor meets a 60-kv base impulse level.

Complete design coordination and exhaustive testing in General Electric's high voltage laboratories of bus, cable, current transformers, contactors, fuses, insulators, and overload relays means top protection for men and equipment!

Ask your G-E sales representative about other advanced-design operation, installation, and maintenance features of new Limitamp control. Or, write today to Section 783-26, General Electric Company, Schenectady, New York for descriptive Bulletin GEA-6893.

Industry Control Dept., Salem, Va.

* Reg. Trade-mark of General Electric Co.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Connectors (24)

A new line of rotary connectors has been announced. Connector is a non-separable, rotary connector for polyphase applications. It can be used for continuous rotation in either direction up to 1,000 rpm or for oscillatory motion. Present construction is 4-wire, 3-phase having a maximum rating of 10 amps at 250 volts. Continuous supply is maintained by four silver-graphite brushes mating with silver-plated slip rings.

Frankel Engineering Laboratories, Inc., Reading, Pa.

Prismatic Lens (25)

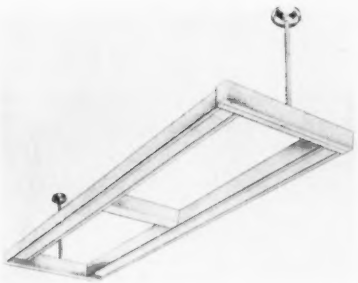
A new light control prismatic lens called Skylens is available. Color corrected lens creates a natural light with an indoor-outdoor environment. Additional features are: UL approved non-combustible material can be used under sprinklers; acoustical absorption in double panel design; made of Lifeguard-150 double laminated material; fits all standard 2- by 2-ft modules for both lighting fixtures and ceilings.

Lightonics, Box 7211, *Oakland* 1, *Calif.*

Lighting Fixtures (26)

A line of explosion-proof lighting fixtures for extremely hazardous areas—Class I, Group A (acetylene) and Group B (hydrogen)—has been developed. Series "E" fixtures are available in pendant, ceiling, bracket and concrete types; with openings for ½ in., ¾ in. and 1 in. conduit; and with various types of steel porcelain enamel reflectors, accommodating 150- and 200-watt lamp sizes. All cast parts are alumiumn.

Killark Electric Manufacturing Co., 3940 *Easton Ave., St. Louis* 13, *Mo.*



Fluorescent Fixture **(27)**

Semi-direct HQ fluorescent fixture features 800 ma high output and 1500 ma very high output lamps. Fixtures are supplied with stems and canopies for pendant mounting approximately 18 in. below ceiling. Shielding available in 45° by 45° plastic louvers or diffuse polystyrene panels for offices, engineering drafting rooms, schools, control centers, stores and other commercial lighting applications.

Sylvania Lighting Fixtures, Wheeling, W. Va.

Enclosures **(28)**

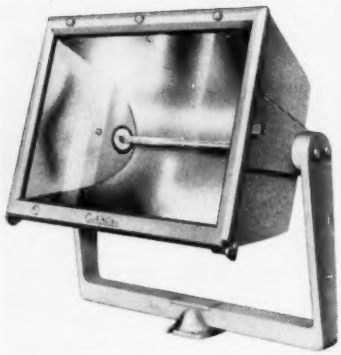
New NEMA Type 12 terminal enclosures and JIC terminal kits have been added to the Boss line. Enclosures come in six stock sizes, ranging from 16- by 12- by 6-in. to 30- by 24- by 6-in., accommodating from two to five vertical straps and providing up to 180 terminals in the largest box. Interior of enclosure, including brackets and straps, is finished in white baked enamel; exterior is gray prime coat. JIC terminal kits, for assembly in standard Boss JIC boxes, include brackets which screw into panel mounting studs. They are available with or without terminal blocks.

Huenefeld Co., 2701 Spring Grove Avenue, Cincinnati 25, Ohio

Trolleys **(29)**

A reduction in maintenance time has been made possible through the incorporation of Ever-lok receptacles in crane and hoist type and transfer type trolleys used with the 100-amp Feedrail "Trolley Busway" and "Crane and Hoist Electrification" systems. A twist of wrist and locking device releases plug fitting into receptacle. Trolley is then lowered through track "door" section. Trolleys are wired complete with 20- or 30-amp receptacles, as desired, and are available in two or three poles. Literature is available.

Feedrail Corporation, 125 Barclay St., New York 7, N. Y.



Floodlight (30)

A new high-intensity floodlight using a 1500-watt Quartz Iodine lamp is now available for a wide range of applications. Housing measures 16⅝ in. wide by 12 in. high by 6¾ in. deep. It can be supplied as wide-, medium- or narrow-beam units. Each of the three models can be pole, wall, overhead or base mounted with same mounting bracket—providing a useful light source for both indoor and outdoor use. In almost every mounting situation, 180° vertical aiming adjustment is possible. Construction is weather-tight. For installations where 240 or 277 volts are not available, a transformer is available to step-up to the necessary voltage.

Guardian Light Co., 500 North Blvd., Oak Park, Ill.

Splicing Compound (31)

A new Neoprene splicing compound, called "Plymprene," is a weather-resistant prime insulation compound. Tape gives protection against oils, alkalies and weather extremes. It is designed for use under any of the standard Slipknot or Plymouth electrical tapes. It has a tensile strength of 300 lbs per sq in. Tape is available in 30-ft by ¾-in. rolls, packed in individual round tins.

Plymouth Rubber Company, Inc., 23 Revere St., Canton, Mass.

Actuator (32)

A new electromechanical Polynoid linear actuator is designed to meet a wide range of requirements. Six models featuring different stroke lengths and output forces are available for testing, evaluation and prototype use. They operate on standard ac voltage and are furnished for foot mounting.

Skinner Precision Industries, Inc., New Britain, Conn.

Pushbutton Station (33)

An explosion-proof, NEMA 7, lighted pushbutton station for use in hazardous areas has been developed. Designed for heavy duty Class 1, Group D service, the unit is completely weatherproof and may be used as either a push-to-test pilot light or as a combination pushbutton and pilot light. It is available in Nelson's line of heavy duty explosion-proof pushbutton enclosures, up to seven units, or as many as 49 separate units may be mounted in a single explosion-proof junction box. All standard colors are available in the molded glass lenses. Units are designed for use at 110, 220 or 440 volts.

Nelson Electric Manufacturing Co., P. O. Box 5385, Tulsa, Okla.

Luminaires (34)

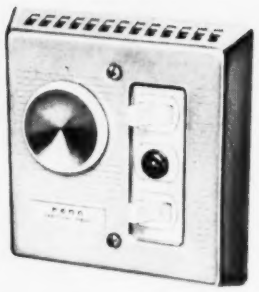
Styled mercury luminaires, rated 400 watts, are available to supplement the units rated 700 or 1000 watts. They are furnished in an aluminum finish or a choice of six pastel decorative colors. They are equipped with scientifically designed glass refractors, one for 400-watt lamps and one for 700- or 1000-watt lamps. They have an internal ballast; mount directly to pole top; light center is 5 ft above pole top.

Line Material Industries, McGraw-Edison Co., Milwaukee 1, Wis.

Tester (35)

Model 113 power tester is a versatile portable instrument for testing ac voltage and current conditions. A selector switch on front panel selects three voltage ranges and four current ranges. Recorder may be used as a direct reading panel meter or, by twist of a knob, as a recorder. It is equipped with test leads for measuring voltages and/or currents with use of a clamp-on current transformer. Over-all accuracy is 3%.

Rustrak Instrument Co., Inc., 130 Silver St., Manchester, N. H.



Thermostat (36)

A new type of room thermostat for electric heating equipment. Designated Type 802 "Switchstat," it includes a sensitive 5000-watt capacity thermostat and provision for mounting as many as three interchangeable wiring devices such as switches, pilot lights or convenience outlets. Especially suitable for service in bathrooms with ceiling type units in combination with lights and exhaust fans. Bulletin No. 3255 is available.

Penn Controls, Inc., Goshen, Ind.

Light Dimmer (37)

A new electronic incandescent light dimmer that fits into a standard single wallbox is now available for homes and commercial buildings. The Dreamliter 600 provides smooth, gradual control of lighting intensity all the way from full dark to full bright on incandescent circuits up to 600 watts. It is the size of an ordinary switch, installs like a standard two-way switch and uses the same two wires, same single wallbox and same standard switch plate. Dimmer can be set at any level of light, for any length of time and can be used to turn lights on and off in a two-way circuit. In three-way circuits it is used in conjunction with the switches.

Electro-Solid Controls, Inc., 8001 *Bloomington Freeway, Minneapolis* 20, *Minn.*

Compound (38)

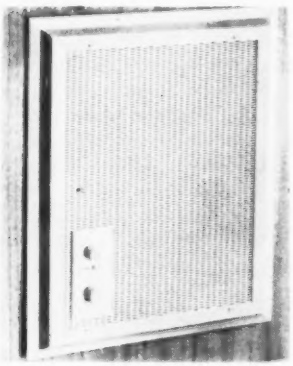
Junction boxes can be bonded to concrete walls with a few dabs of plastic steel, a specially improved epoxy. Junction boxes, as well as piping or other fixtures, can also be bonded to cinder block, tile, steel beams, machinery, wood, brick, plastic or other surfaces. Bond hardens without heat or pressure.

Devcon Corporation, Danvers, Mass.

Stud Gun **(39)**

A new and complete line of cartridge actuated tools, loads and studs is being marketed under the trade name of Stud Gun. Included in the line are: 48 different sizes and types of studs in both ¼ in. and ⅜ in. dia; 11 American cartridge loads including .22, .25 and .38 caliber. Studs feature AUS-tempering. Studs and loads are interchangeable with other American makes.

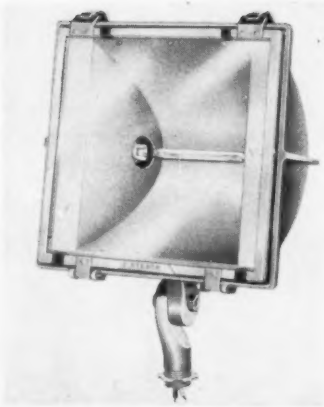
Chicago Expansion Bolt Co., 1338 *W. Concord Pl., Chicago* 22, *Ill.*



Wall Heater **(40)**

A new, high-capacity forced-convection wall heater, to be mounted in wall of a new or existing construction, is now available. Volume flow from forced-convection wall heater permits them to be used for auxiliary heating in entire rooms to supplement existing warming systems. The automatic thermostat has a separate selector dial from on-off switch and is completely enclosed in cool air intake area to prevent interaction with heating element. Separate on-off switch eliminates resetting of thermostat dial for each use. A thermal overload device cuts off heating element in event of obstructed air flow. Listed by UL.

General Electric Co., Electric Comfort Heating Section, Appliance Park, Louisville, Ky.



Floodlights (41)

Quartz-iodine floodlights are manufactured in 500- and 1500-watt sizes each with three different beam spread—narrow, medium and wide. They are identified as Steber 7000 Series Quartzliters and are available with two basic forms of mounting. Swivel mounting types have a hollow universal arm with ¾ in. male thread, for completely enclosed wiring. Universal adjustment types have a U-shaped yoke for which various types of mounting adapters are available—cross-arm, wall, pipe clamp or pole top. All aluminum housings have cast integral cooling fins to maintain correct operating temperatures for long lamp life. Quartzliter Bulletin No. 1103-61 is available.

Steber Division, Pyle-National Co., Inc., 2700 *Roosevelt Road, Broadview, Ill.*

Cord Reels (42)

A new series of industrial duty electric cord reels has been introduced. They are made in two sizes: No. 925, equipped with 20 or 25 ft of cord; and No. 945, with 35 or 45 ft of cord. Both reels are constructed of heavy gauge materials. After reel is mounted, lead-in cable may be plugged into nearest convenience outlet, providing out-of-the-way storage for drop cord lighting installations.

Daniel Woodhead Co., 15 *N. Jefferson St., Chicago* 6, *Ill.*

Transformer (43)

This new high capacity "do-it-yourself" transformer, called the Flexiformer packaged transformer primary Type TP1000, is designed to be used as a temporary or permanent source of ac voltage or current transformer. The required number of winding turns are hand-threaded through the center opening. When used as a source of ac voltage, the input rating is 120 volts, 50/60 cycles single phase and output rating is 1000 VA. When used as a current transformer, the Flexiformer winding becomes the secondary winding and a current carrying conductor passing through the center opening serves as the primary.

Superior Electric Company, Bristol, Conn.

Fluorescent Fixture (44)

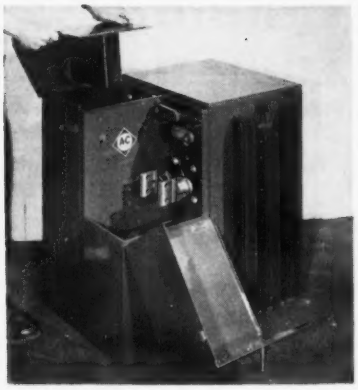
The Duplex-a-lite is a fluorescent lighting fixture of new, twin-lens design. Fixture features twin lamp chambers and optically designed prismatic lenses that direct and distribute most of the light downward. Ceiling and center channel cover are softly illuminated. Unit is available in 4- and 8-ft lengths for Rapid Start and Slimline lamps, with a choice of clear, Acrylic or Polystyrene lenses. It is for use individually or in continuous rows, and is 13⅞ in. in width. Each lamp is enclosed by a self hinging plastic lens which is supported by continuous flanges on the channel. Designed primarily for surface mounting, it can also be suspended.

Miller Company, Meriden, Conn.

Fault Finder (45)

New fault finder locates breaks in electric heating cable embedded in finished dry wall or plastered ceilings. Unit can also be used to spot plastered-over outlets, junction boxes, and wiring within walls. This transistorized, battery operated unit consists of a transmitter signal pack, a receiver pickup pack with telescoping antenna probe, and earphone headset.

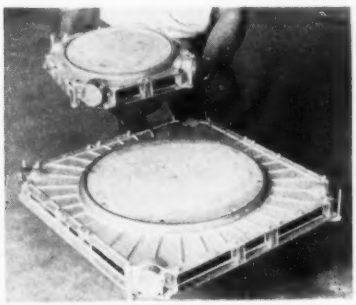
Electric Radiant Heat, Inc., 1517 *Wells St., Fort Wayne, Ind.*



Transformer **(46)**

A new line of low-profile, single-phase, surface-mounted residential transformers, Type SMRT. Transformer is available in sizes 25 through 50 kva, 15 kv and below with a 240/120 secondary rating. Its high voltage interrupter switch is capable of interrupting full load current. The 50-kva residential transformer weighs 750 lbs complete. Its one-size 28½ in. high tank and removable cable compartment accommodates all kva and voltage combinations. It occupies 3-ft-sq area. Entire cable compartment can be removed for installation and maintenance. Primary switch and secondary breaker operating handles are located in low voltage side of cable compartment. A grounded steel barrier completely separates the high and low voltage.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



Junction Box **(47)**

New design of jumbo-size junction boxes feature 1½-in. conduit feeds from the corners and adjustable rings which can be raised or lowered to finished concrete floors without removal of covered plates. Base is 14-gauge galvanized steel; interior partitioning and top sections are cast iron. Boxes furnished with flush-type linoleum rings or flange-type linoleum pans.

Wheatland Electric Products Co., Carnegie, Pa.

Catalogs & Bulletins

(48) PLANT EQUIPMENT Catalog 33, 64 pages, describes complete line of maintenance, safety and production equipment with buying data covering 110 different products. Martindale Electric Co.

(49) LIGHTING. Brochure AIA File 31-F-2 describes the new Lok-Electric extruded aluminum pendant lighting systems making possible luminaire distribution efficiency of 90% using 1500 MA lamps. Lok-Products Co.

(50) POWER FUSES. Bulletin FC4 describes Type HXO power fuse, rated at 200 amps, and has asymmetrical interrupting rating of 20,000, 15,000, 9000, 5000, and 4000 amps at 8.25, 15.5, 25.8, 38 and 48.3 kv, respectively. Line Material Industries, McGraw-Edison Co.

(51) CUSTOM LIGHTING is title of 16-page booklet which presents many examples of custom lighting installations. Frink Corp.

(52) SILICON RECTIFIERS. Bulletin GEA-7066 gives detailed information on the features, operational characteristics and construction of new line of silicon dc power supplies rated .75 to 75 kw. General Electric Co.

(53) LIGHTING. 16-page brochure features new Endura Series of incandescent lighting fixtures, with illustrations, diagrams, descriptions and specifications for each of the series. Litecraft Manufacturing Corp.

(54) MAGNETIC CLUTCH. Bulletin 6005-2, "How a Vickers' Magneclutch Works," contains an explanation of magnetic particle and friction clutches. Vickers, Inc., Electric Products Div.

(55) METALCLAD SWITCHGEAR. 42-page Bulletin GEA-5664F provides features, installation data, dimensions and ratings of switchgear ranging from 2.4 to 13.8 kv and 75 to 1,000 mva. General Electric Co.

(56) TRANSFORMERS. Bulletin 611 describes line of "Quiet Quality" dry-type transformers from ¼ to 10,000 kva. Sorgel Electric Co.

(57) AIR-HANDLING TROFFER. 20-page brochure contains illustrations and technical data on combination air-handling troffers. Sylvania Electric Products Inc.

(58) FLOODLIGHTS. Bulletin 2727 "PAR-beam Floodlights" describes new sealed-beam lamp floodlight series. Crouse-Hinds Co.

(59) DIAL TIMER. Bulletin N-305B describes new Series 305B automatic reset dial timer including data on construction, installation, application, specialized functions, electrical data and basic circuit arrangements. Automatic Timing & Controls, Inc.

(60) ELECTRONIC TIMER for automatic operation of electric circuits is described in Bulletin 120. Farmer Electric Products Co., Inc.

(61) POWER PLUGS. Bulletin F54 describes new Arc-Safe electrical power plugs. Joy Manufacturing Co., Electric Products Div.

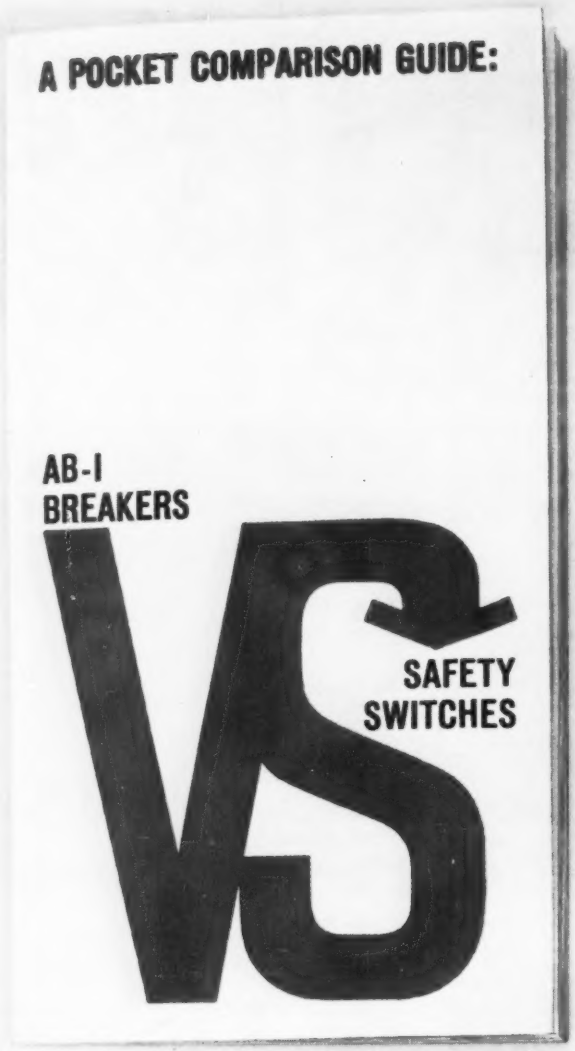
(62) ELECTRIC HEATER. 30-page catalog describes 300 models of built-in and portable electric heaters with dimensions and specifications. Markel Electric Products, Inc.

(63) LIGHTNING ARRESTERS. Bulletin LA2, revised May 1961, covers application features, ordering and dimensional information on three types of lightning arresters. Line Material Industries, McGraw-Edison Co.

(64) BELLS. Bulletin 2.8 "Vibrating Valubel" and Bulletin 2.11 "Single Stroke Valubel" describe savings in current drain and installation costs of new indoor and outdoor single stroke and vibrating bells. Wheelock Signals, Inc.

(65) SILICONES. 8-page Bulletin CDS-288 entitled "Silicones for Electrical Insulation" contains 20 photographs and charts providing data and examples of silicones in use in a variety of electrical and electronic applications. General Electric Co., Silicone Products Dept.

(66) SWITCHES. Detailed results of an extensive test series conducted on the Pringle load break switch for service entrance application are presented in 8-page Test Data Bulletin P-112. Pringle Electrical Mfg. Co.



We make both but we recommend AB-I Breakers over Safety Switches. Why?

Why are we so sure the new Westinghouse AB-I Circuit Breaker is better than any safety switch? We should know. Westinghouse makes safety switches, too—the best you can buy. Read the whole story in this 32-page "Pocket Comparison Guide." Ask your Westinghouse distributor or sales representative for your free copy, or just use the reader service card in this magazine. Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa.

You can be sure . . . if it's

Westinghouse

J-30328

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Pulling Wires in Conduit

QUESTION S39—In my work I am often confronted with the problem of long underground conduit runs, mostly for 480-volt branch circuits for motors from 3 hp to 200 hp. The runs are sometimes so long or difficult, that intermediate pull boxes must be installed. For this purpose, I would appreciate getting a simple formula or table based on practical experience to determine the maximum length of pull under the following conditions:

Conduit run to be rigid steel, one 90° vertical elbow at each end of the conduit run. Radius of elbow is two times the minimum radius specified in NEC Table 346-10; horizontal bends to be long sweeps; cable to be Type RHW or THW.

For big cables and critical conditions, I use the lengthy method given in a handbook.—J.A.

ANSWER TO S39—Your question seems to hinge on the maximum length of conduit that can be used underground where two elbows are used and horizontal bends are long sweeps. You indicate the use of Type RHW or THW conductors. As you say, there are lengthy formulas in handbooks that will offer a solution. However, none of these formulas is of much value unless practical aspects are considered. There are many factors involved, such as the fishing and pulling equipment available to the installer, pulling compound, well-supported conduits, the method of serving the conductors to the fish tape or pulling cable, and feeding conductors into the conduit without kinks or crossing. And certainly swabbing conduits prior to installing conductors eases the pulling job.

Much information along this line can be obtained from the several manufacturers of modern fishing and pulling equipment. Manufacturers' pamphlets cite actual field cases where runs up to 600 or 700 ft have been pulled with little difficulty.

On difficult pulls it is a good idea to blow soapstone or similar material into conduits after swabbing the conduit. Following this, use a hand-operated or power winch to pull in conductors. Such equipment is recommended because a steady continuous pull can be accomplished, which means that it takes less power to keep the conductors moving than to start them again after they have been stopped.

From the foregoing, it can be seen that a table or formula for maximum pulls is not too practical. Equipment and installation know-how count most.—H.W.J.

Mineral-Insulated Cable

QUESTION T39—I have a question regarding use of mineral-insulated cable, single-conductor type. From calculation or experience, can you tell me if appreciable or harmful, induced currents or heat rise in the sheath will result from the use of the larger size cables on alternating currents?—D.L.

ANSWER TO T39—Mineral insulated cable, Type MI, is one of the safest wiring methods. It is approved for almost all locations, dry, wet, exposed, concealed, even in hazardous locations. See NEC Section 330-2. No harmful heat rise in the sheath will occur if the current carrying capacities given in the NEC are observed as the cable manufacturers have carefully considered this problem. Special attention must be given where a single-conductor cable, carrying more than 50 amps, enters a metal enclosure. See NEC Section 300-20.

General Cable Corp., a manufacturer of type MI cable, has among their literature an interesting article describing an installation using three No. 4/0 single-conductor Type MI cables used as a feeder for a 200-hp motor.

If the cable is used for an application requiring special consideration, for example, for ac over 60 cycles, the problem should be referred to the cable manufacturer. —J.A.

ANSWER TO T39—Section 330-1 of the NEC recognizes Type MI cable in single- or multi-conductor form. It may be installed in a raceway or duct or may be run as a wiring method in itself. When single-conductor MI cable is used on 60-cycle ac circuits, induced current will not exist between cable sheaths because the sheath is made of copper, which is a non-magnetic material. The only precaution necessary is where the cables enter an enclosure of magnetic material (such as a steel junction box). In such instances, cut a slot between the knockouts for each connector that supports each single-conductor MI cable, particularly where the load current will exceed 50 amps. This will eliminate the effect of induction at the steel enclosure. Slotting will not be necessary if the boxes to which single-conductor MI cable are connected are constructed of non-magnetic material. Many installations of MI cable have been made, as previously described, without adverse effects.—J.H.W.

Static Removal

QUESTION U39—Being a maintenance foreman of a large printing plant, I am plagued with static in the letterpress printing, offset printing, folding and ruling machines.

If any readers are familiar with the printing equipment or any others have static problems, I would be grateful if someone could suggest or diagram a homemade remedy for removing static.—C.W.P.

ANSWER TO U39—An effective way is to get a 15000-volt transformer. One terminal is attached to an insulated pipe having many points that are placed 1 to 4 in. from the charged moving material. This charged alternating field will discharge positive or negative charged items, and will not rust the machinery like the high humidity system does.—H.S.

ANSWER TO U39—The solution to the question is keeping the atmosphere at the letter press at the proper value of humidity. This can be done by installing suitable humidifying equipment over the press or in the near vicinity. Doubtless the press manufacturer can

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Remember your last conduit job . . . all the time and work needed to install junction boxes, not for new circuits but just so the cable could be pulled around corners? And the longer the pull, the more boxes you needed. USS Tiger Brand Armorlokt Cable could have been installed in approximately one-half the time and eliminated all that expensive pipe fitting and bending. ■ Armorlokt installs as easily as ordinary cable—yet it protects as well as rigid conduit, and sometimes even better because Armorlokt is flexible and "rolls with a punch." You can install it anywhere . . . up, down, across walls, buried in the ground, suspended in trays or on cable rings, indoors or outdoors. Armorlokt can be installed in long lengths, because its flexible construction permits easy and quick bending around corners, I-beams, or any other obstruction. And you can easily splice into Armorlokt Cable, anywhere along the entire length. ■ Armorlokt has a higher current-carrying capacity than the same size conductor in conduit because heat is quickly dissipated, not trapped inside. Corrosive atmospheres are no problem. Armorlokt is available with galvanized steel, stainless steel, aluminum or bronze armor. It's also available with an Ampyrol (PVC) jacket, in black or colors for easy identification. You can order Armorlokt with almost any kind of insulation, including varnished cambric, rubber, or asbestos up to four inches in diameter, rated 15,000 volts. ■ There's a standard USS Tiger Brand cable for every special job. For the complete story on Armorlokt Cable or any other type cable, call our nearest sales office or write American Steel and Wire, Dept. 1226, Rockefeller Building, Cleveland 13, Ohio.

recommend equipment available on the market. This situation is similar to the condition in cotton thread producing establishments where steam atomizers are installed and the humidity values are automatically maintained.—C.O.D.

ANSWER TO U39—The problem of static is quite a serious one. There are a number of solutions which have been used rather successfully. Among them I list the use of a brush discharge where a comb of fine pointed wires extend over the material and discharge the material. This seems to work out fairly well.

Another system is to use a bar containing some weak radioactive source such as polonium. These sources are available through any of the nuclear distribution houses. This will also do a good job.

The simplest way however, is to control the humidity in the printing plant. In general, it will be found that with controlled humidity, not only will the problem of static disappear but so will the problem of paper creasing and folding.—H.H.S.

Stray Ground Currents

QUESTION W39—In our new installation, we have sensitive electronic instruments such as hysteresigraph X-ray diffractometers and others. We are experiencing inconsistent readings with these instruments ever since we moved into our new building. We were told that stray, building ground currents cause this erratic operation. Is this so? If so, what can we do to eliminate this condition?—J.A.M.

ANSWER TO W39—We have several X-Ray diffractometers in service and had experienced a considerable amount of inconsistencies. After a lengthy investigation we concluded that the erratic operation was due to the following:

1. Voltage fluctuations or transients.
2. Building ground currents.
3. Air-borne electromagnetic waves.

To minimize the effects of the above, we installed the following:

1. A motor generator set to provide transient free power.
2. A complete isolated-from-ground neutral for our 208/120-volt 3-phase power distribution system. The transformer for this

system was grounded through a manual disconnect. This was necessary to facilitate the locating of grounded equipments by allowing us to open this ground connection and use standard ground locators.

3. A ground alarm system.

4. Proper shielding for our instrumentation areas.

We now get excellent results from all our instrumentation set ups.—H.E.H.

ANSWER TO W39—It is possible that stray ground currents could be the cause of your difficulty. If such is the case, it can be controlled to a very good extent if a solid ground rod is located. What has been done is to provide a grounding bus of heavy copper wire around the room and make sure that all metallic instruments and apparatus are solidly grounded to this bus. The bus itself must be solidly grounded to an external ground.

This will clear up most of the trouble. If there are other stray currents in the structure, these usually will disappear or diminish to a negligible extent when the grounding is proper.—H.H.S.

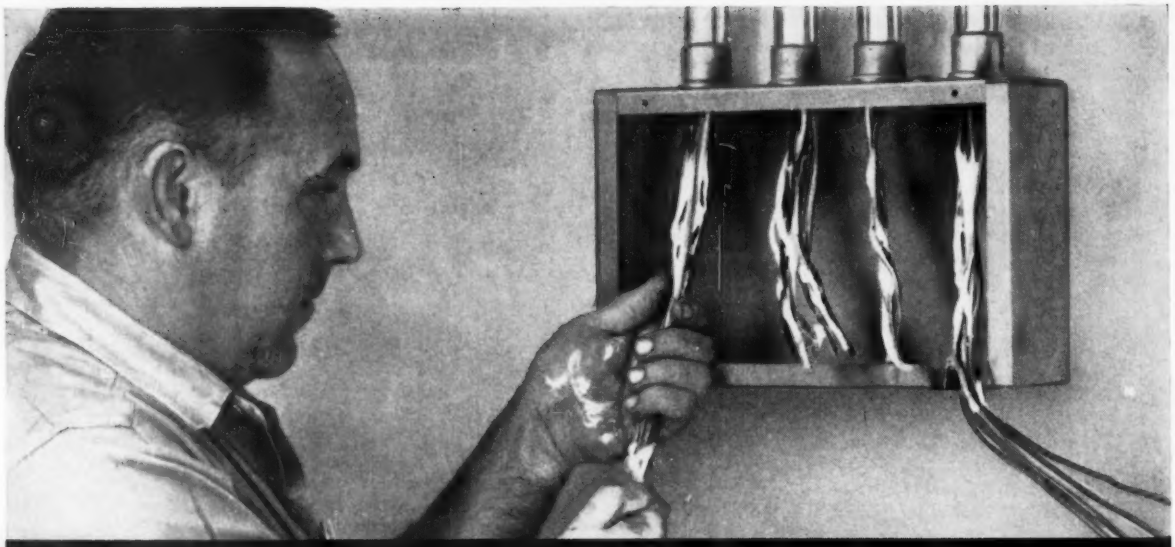
Can You Answer These QUESTIONS?

QUESTION E40—Do motor rewind shops consider substituting magnet wire by pairing two smaller sizes for a larger one? Is this a good practice? Also, does two of every third smaller size equal the original; for example, two No. 20 wires equal to one No. 17, or two No. 14 wires equal to one No. 11. Does this hold true in all wire sizes?—E.S.H.

QUESTION F40—Copper is forming on the trailing edge of the commutator bar on one of our large dc machines. This eventually builds up in the undercut slots and short circuits the bars. To date we have been unable to correct this condition permanently. Can someone with similar experience suggest the cause and correction?—R.E.B.

QUESTION G40—In short-circuit calculations, how does one go about obtaining or calculating the reactance of the utility supply system? What is meant by the term "infinite bus"?—J.A.M.

PLEASE SEND IN YOUR ANSWERS BY SEPTEMBER 15



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Save time and money installing cable in conduit . . . protect cable from damage . . . assure service continuity . . . with a cable lubricant engineered for your job's requirements.

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Burndy SLIKON, for cable covered with rubber, many kinds of plastic, or lead, for installation in steel or aluminum conduit.

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Burndy IMPROVED CABLE PULLING COMPOUND, specifically for lead-covered cable for installation in ducts of all types.

Burndy PROTECTANT 626, for lead covered cable for installation in ducts and manholes subject to flooding and other severe conditions.

BURNDY

61-19

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Questions on the Code

Answered by:

B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Load Calculations Dwelling Occupancies

Q. *I am working on some electrical apprentice lesson material and would appreciate your opinion on the interpretation of Paragraph 220-2(a-1) of the National Electrical Code.*

Below is an illustration to present a clearer picture of the question.

I have excluded by heavy lines certain areas which I believe need not be included in the watts-per-sq-ft method according to Paragraph 220-2(a-1). In the final analysis, we have a total of 1440 sq ft which results in a calculated wattage of 4320 watts. This seems to satisfy Paragraph 220-2(a-1).

In addition to the above calculated wattage, we have 2250 watts of outdoor floodlighting, porch brackets and garage lighting, plus three convenience outlets in the garage and six weatherproof outlets located at different points around the outside of the house.

Are we to assume that this additional load is covered by Paragraph 220-2(a-1) or is it to be added to the watts-per-sq-ft calculations?

The examples in Chapter 9 do not seem to cover this problem specifically nor does Abbott's Codebook.

Another question that comes to mind is what is meant by "outside dimensions." For instance, in the upper portion of the living room on the sketch, if the inside measurement between the open terrace and the open porch were found to be 15 ft, and further assume that the total wall thickness was 12 in. (each wall), then would 15 ft be the proper dimension to use or would 17 ft be the proper dimension to use?—R.C.M.

A. For the convenience of our readers, the provisions of Paragraph 220-2(a-1) of the code are quoted as follows:

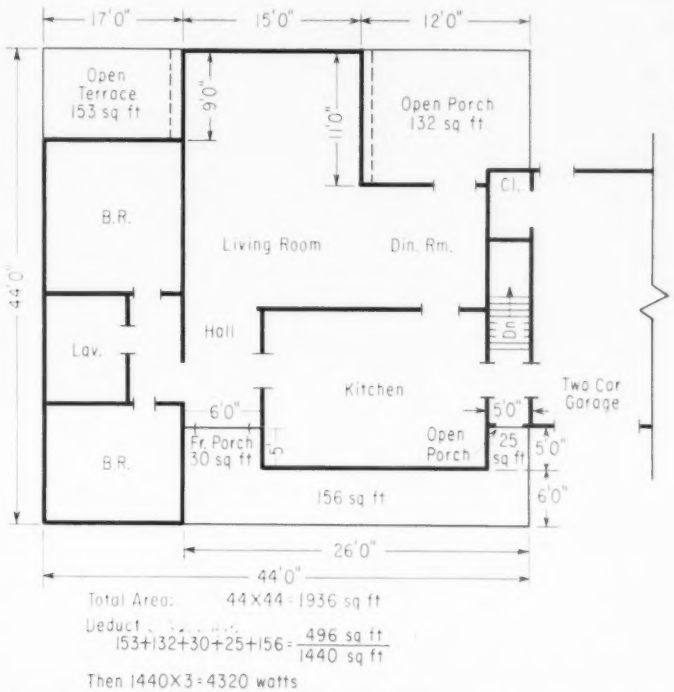
"(a) General Lighting Load.

"(1) In Listed Occupancies. In the occupancies listed in Table 220-2(a), a load of not less than the unit load specified shall be included for each square foot of floor area.

"In determining the load on the 'watts-per-square-foot' basis, the floor area shall be computed from the outside dimensions of the building, apartment or area involved, and the number of floors, not including open porches, garages in connection with dwelling occupancies, nor unfinished spaces and unusable spaces in dwellings unless adaptable for future use."

Your diagram clearly illustrates the provisions of this code rule, and your computations are correct. You have used the outside dimensions of the dwelling in arriving at the total sq ft area. You have deducted the open porch area, and the adjacent garage area is not included in the computations. As a result, the gross wattage required for the "General Lighting" of this dwelling is 4320 watts, and it appears obvious that it does not cover the additional load for outdoor lighting, garage lighting or the six weatherproof outlets located at different points outside the house. In the absence of specific code rules covering the status of such loads, it appears to me that the provisions of Paragraph 220-2(b) applies. This paragraph concerns loads other than that provided for general illumination. If this assumption is correct, the 2250 watts of outdoor floodlighting, the porch brackets and garage lighting must be recognized in the branch-circuit and feeder calculations. I don't believe, however, that any special consideration is necessary for a couple of small porch brackets since many inspectors consider such outlets to come within the scope of Paragraph 220-2(a-1) covering general lighting.

The provisions of Paragraph 210-22(b) requires grounding-type outlets to be installed on open porches, breezeways, garages, and on the exterior surfaces of outside walls. The status of the circuit serving such outlets with respect to branch-circuit loading is not definitely established as in the case of the 20-amp appliance circuits which are rated at 1500 watts per circuit. As a result, it is my opinion that the six weatherproof receptacle



In addition to the above calculations, there are 2250 watts of outdoor bracket lights, floodlights & garage lighting plus 3 convenience outlets in garage & weatherproof outlets on outside of residence.

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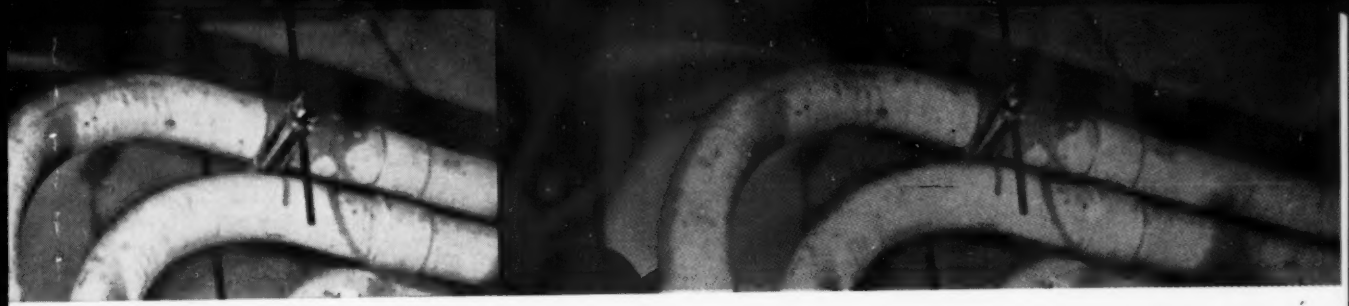


ROME TYPE RHW BRAIDED BUILDING WIRE

U/L Listed for 75°C wet or dry—600 volts

COPPER			ALUMINUM			SAVINGS	
SIZE	STRANDS	LIST PRICE	SIZE	STRANDS	LIST PRICE	DOLLARS	PERCENTAGE (Approx.)
6	7	$77.60	4	7	$63.40	$14.20	18%
2	7	155.40	1/0	19	117.00	38.40	24%
4/0	19	477.80	300 MCM	19	350.00	127.80	26%
500 MCM	37	1098.30	750 MCM	61	814.00	284.30	25%

outlets located on the exterior wall of the dwelling and the three outlets installed in the garage should be rated at 1½ amps each as covered by Paragraph 220-2(b). This appears to be the only code rule which applies. While such receptacle outlets may be used to serve portable appliances such as drills, saws, hedge trimmers, lawn edgers, lawn mowers, etc., they also may be used to supply portable lighting fixtures or Christmas decorations. As a result, circuits serving such outlets could not be classified as appliance circuits, and the code does not recognize them in this classification.

A summary of the foregoing indicates to me that the 2250 watts of floodlighting should be considered as an individual load. The convenience outlets should be considered on the basis of 1.5 amps per outlet. I also believe that such loads, in computing the size of a feeder, should be grouped with the general lighting load and the small appliance load, so that the feeder demand factor of Table 220-4(a) would apply. If the dwelling in question comes within the scope of Section 220-7, the optional method of calculating feeder or service capacity would apply and such loads would be included in the "remainder of other load" and be subject to the 40% demand factor covered by Table 220-7.

The term "outside dimensions" as used in Paragraph 220-2(a-1) appears to be covered by your illustration. While the open porches and terrace are not considered to be a floor area, it appears to me that your method of arriving at the correct floor area satisfies this code rule. The living-room floor area should be computed on the basis of the 17-ft dimension which includes the 1-ft thickness of each wall.

With the advent of outdoor living, many of the normal functions of a dwelling occupancy are transferred to outdoor areas such as the patio and the open porch. Through the use of portable electrical appliances, food is cooked, prepared and served in such areas. Radios and TV sets are used for amusement. Garden spotlighting is increasing in popularity. The use of white, colored or even blacklight continues to provoke the interests of many householders who wish to enjoy and display the beauty of their gardens. Swimming pools have underwater lights and overhead floodlights. Portable tools and other electrical appliances have become commonplace to dwelling occupancies. How are such loads to be computed? What demand factors should apply? Such are the questions which arise when one endeavors to apply existing code rules. In the absence of more specific rules, opinions will vary and the degree of safeguard intended by the code may lag behind the minimum. To me, the time has arrived when the outdoor loads of a dwelling occupancy should be covered by the code to the extent provided for the interior loads. If we desire the public we serve to enjoy outdoor electrical living, the code should recognize the hazards involved and provide accordingly.—B.A.McD.—8/61/1

High-Voltage Ballast Conductors

Q. *The open-circuit voltage of a particular fluorescent ballast exceeds 600 volts—actually 795 volts. What voltage rating is required on conductors used to remotely locate these ballasts?—D.N.*

A. The conductor insulation shall have a minimum voltage rating of 1000 volts. This is the next standard higher voltage rating above 600 volts as recognized by Paragraph 310-2(h).—B.Z.S.—8/61/2

Conduit Draining

Q. *Recently I have had two cases of trouble with water or condensation in runs of conduit. These conduits were exposed to the weather by being laid on top of a flat roof. Such conduit contained conductors for operation of motors on a cooling tower in connection with air conditioning systems.*

What precaution can be taken to prevent reoccurrence of water or condensation accumulating in this conduit?—C.R.W.

A. Under Article 346, Rigid Metal Conduit, and Article 348, Electrical Metallic Tubing, under Sections 346-4 and 348-4, Wet Locations under Installation, the following will be found:

"Wet Locations. In portions of dairies, laundries, canneries, and other wet locations, and in locations where walls are frequently washed, the entire conduit system, including all boxes and fittings used

therewith, shall be so installed and equipped as to prevent water from entering the conduit and the conduit shall be mounted so that there is at least ¼-in. air space between the conduit and the wall or other supporting surface.

"All supports, bolts, straps, screws, etc., shall be of corrosion-resistant materials or protected against corrosion by approved corrosion-resistant materials."

You will note from the above that it is stated the conduit shall be so installed and equipped as to prevent water from entering the conduit. Your attention is called to Section 730-23, Raceways on Exterior Surfaces of Buildings: "Raceways on exterior surfaces of buildings shall be made raintight and suitably drained." Your attention is also called to Section 230-52 under Services, which states: "When rigid metal raceways are installed where exposed to weather the raceways shall be made raintight and arranged to drain."

From the above, the conduit on a roof structure would be elevated to drain with a drain hole provided for any condensation or moisture that may accumulate in such raceway.—R.E.W.—8/61/3

Rating of High Temperature Wire

Q. *Is it permissible for the use in fluorescent fixtures a wire that is stamped "Machine & Tool" with 90°C rating but shows no UL Label?—K.M.*

A. No. While the conductor insulation may be stamped with a 90°C rating as a machine and tool wire it still may not be suitable for a fixture wire. There are such types of wire available for use as both an appliance wiring material and also as fixture wiring. But great care must be exercised in properly applying the wiring material to the specific wiring problem at hand.

For example, the G.E. Co. has a "Flammenol Machine Tool, Appliance and Fixture Wire" having an SI Number 58170. The G.E. Co., in their catalog, is very meticulous in stating the exact application of this wire and also gives a concise UL listing for many applications.

Primarily, the 90°C labeling applies only when the wire is used in appliances where the conductors are not exposed to oil. For fixture wiring it is still rated as a 60°C conductor.—B.Z.S.—8/61/4

Derating Factors Raceway Fill

Q. *I would like to know if Note 8 of Tables 310-12 to 310-15 about more than three conductors in a raceway apply to motor circuits too. I am referring to derating of the conductors. I am about to wire a grain cleaner in a farm elevator. The cleaner is driven by a 7½-hp single-phase motor. There will be a small leg by this mill to elevate the clean grain which will be driven by the ½-hp motor. I don't believe there is a code violation for running all the conductors in one raceway, but do I have to derate these conductors since they will carry 125% of the full-load current of the motors?*

The size of the conductors that would be used if the raceways were single would be No. 6 for the 7½-hp motor with No. 14 for the control circuit and either No. 14 or 12 for the ½-hp motor. All conductors would be copper, the size of the conduit would be 1¼ in. I would increase the wire sizes to No. 4 for the large motor, No. 14 for the control wires and No. 12 for the ½-hp motor and still use the 1¼-in. conduit. If derating applies in this case how can you derate motor conductors when they are generally fused more than the carrying capacity because of starting current? Would it be better to run two separate conduits? See sketch below. —R.B.

A. For the convenience of our readers, Note 8 concerns the allowable current-carrying capacity of a conductor when more than three are installed in a raceway or cable. When four to six conductors are installed in a raceway the current-carrying capacities given in Tables 310-12 and 310-14 are reduced to 80%. For seven to 24 conductors, the reduction is 70%, etc. When current flows in a conductor, heat is generated in proportion to the square of the current times the resistance of the conductor. When more than three current-carrying conductors are installed in a raceway, a problem of heat dissipation arises. The more conductors the greater the heat, and excessive heating will damage the conductor insulation. In order to minimize this hazard, the code reduces the maximum current-carrying capacity of each conductor by the percentages covered by Note 8.

The provisions of Section 430-22 require motor branch-circuit conductors to have a carrying capacity of not less than 125% of the motor full-load current rating. An exception is made for motors that are not rated for continuous duty. The provisions of Section 430-22 recognize the motor running overcurrent (overload) protection to be rated as high as 125%. Note the use of the word overload. The occasion for this rule is prompted by the fact that motors are designed to operate at overload for specified periods of time, and they may be subject to small overloads for short periods of time. In order to satisfy such conditions of operation, the code requires the circuit conductors to be rated at 125%, and the overcurrent device protecting the motor to be set as high as 125% of the motor full-load current rating.

In view of the foregoing, we have two distinct conditions which must be satisfied. One concerns the heating of the conductors in the raceway, and the other concerns the possibility of motor overloading. Both conditions must be satisfied.

It is also significant to note the exception provided in Note 8 which is quoted as follows:

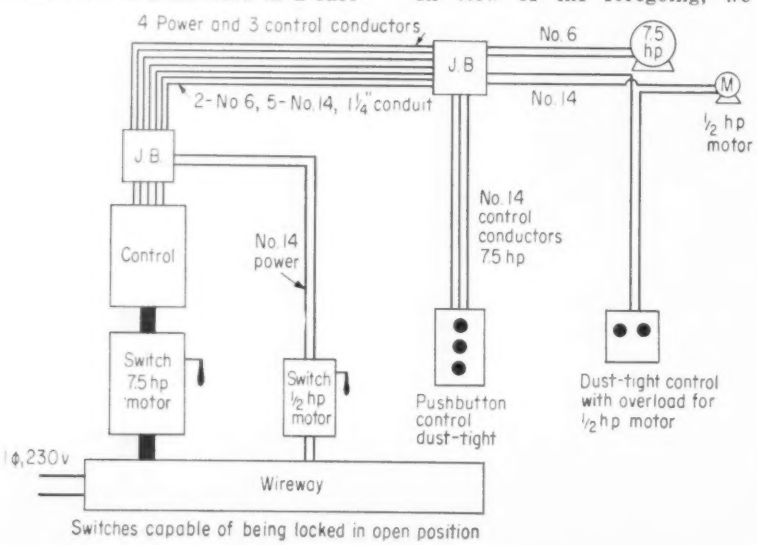
"When conductors of different systems, as provided in Section 300-3, are installed in a common raceway the derating factors shown above apply to the number of power and lighting (Articles 210, 215, 220 and 230) conductors only."

Reference to Section 300-3(d) indicates that motor control conductors are considered to be different systems. As a result, they would not be involved with derating. According to your proposed wiring design, we have two power circuits consisting of four conductors in a common raceway. As a result, their current capacity must be reduced by 80% of the values given in Tables 310-12 for copper conductors.

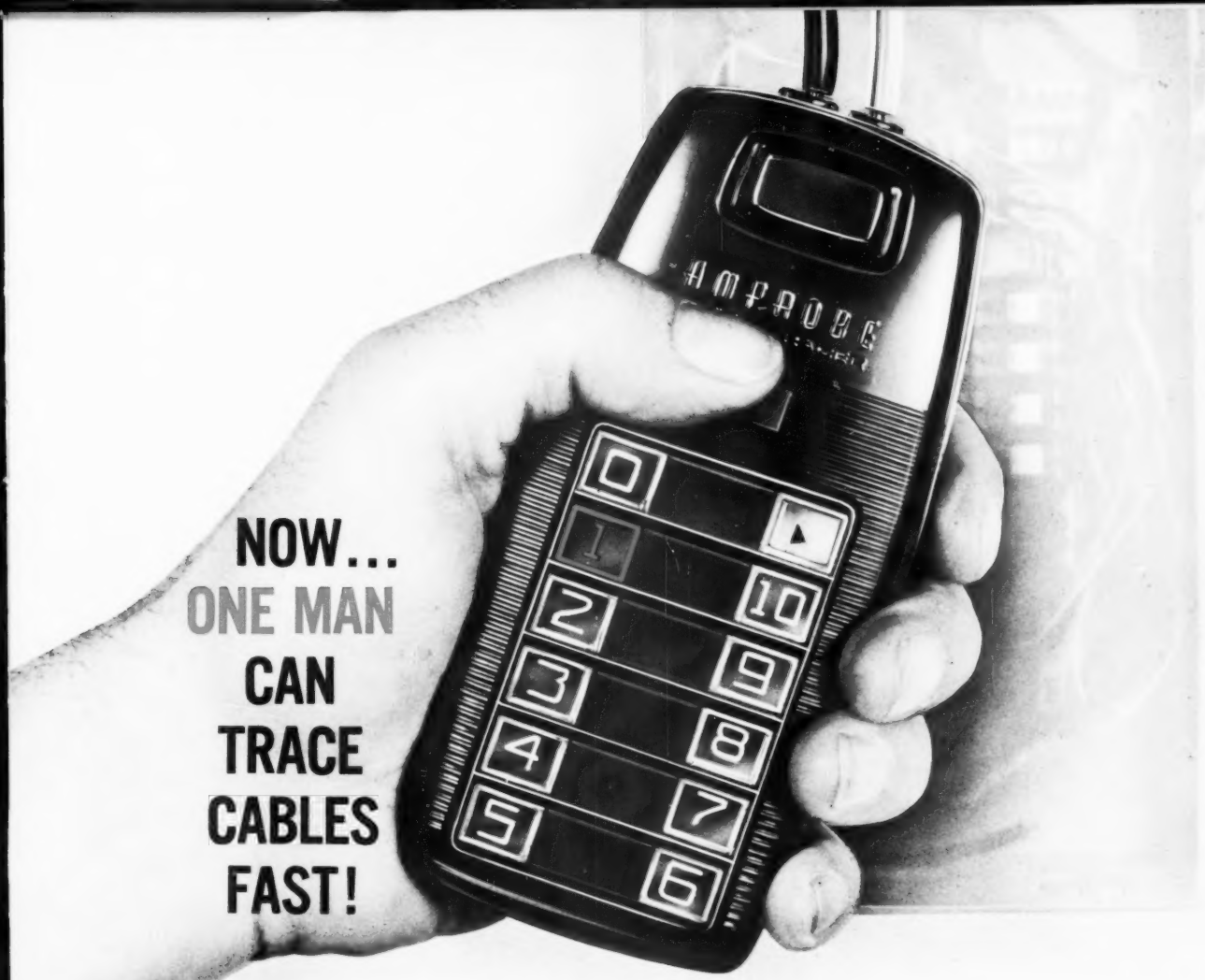
A 7½-hp, 230-volt, single-phase motor has a full-load current rating of 40 amps, as covered by Table 430-148. The size of the branch-circuit conductors serving this motor would be 125% of 40, which is 50 amps. A No. 6, Type R conductor has a current capacity of 55 amps. Subject to 80% derating, its current capacity becomes 44 amps. This capacity does not satisfy code rules. A Type RH No. 6 conductor with a current capacity of 65 amps, subject to derating (52 amps) would satisfy both rules. A No. 4, Type R conductor also would satisfy both rules.

The ½-hp, 230-volt, single-phase motor has a full-load current rating of 4.9 amps. And 125% of 4.9 results in 6.1 amps. The current capacity of a No. 14 conductor, subject to 80% derating, is 12 amps. The No. 14 conductor satisfies both code requirements.

If we use one conduit to do the job, we could run the two No. 6 RH conductors, or two No. 4 R conductors, together with the five No. 14 conductors in a 1¼-in. conduit. If you decide to run separate conduits for each motor you may have two No. 6, Type R and three No. 14 in one conduit. The total area of this wire combination, (0.3457 sq. in.) exceeds the 40% area of a 1-in. conduit, (0.34 sq. in.) by 57 thousands of a square inch. Some inspectors might discount the significance of square inches measured in the thousands and permit the use of 1-in. conduit.



Switches capable of being locked in open position



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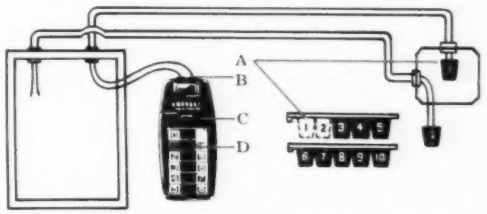

1. Simply plug one end of conductors to be traced into numbered Station Blocks (A).
2. Plug other ends into Receptacle (B) at top of CABLE TRACER.
3. Press Indicator Button (C).
4. The number on CABLE TRACER'S Indicator Panel (D) corresponding to the Station Block at the other end of the conductor being traced (No. 1, in this case) *lights up* to provide identification–instantly, clearly, unmistakably! Using all the Station Blocks, ten conductors can be traced at one time.

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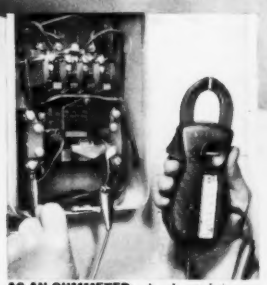
AS AN AMMETER: snapped around conductors to balance circuits.



AS AN OHMMETER: check resistance of motor control solenoid coil.

AS A VOLTMETER (large photo): check voltage on slipring of motor.

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, NEW YORK *Canada: Atlas Radio Corp., 50 Wingold Ave., Toronto, Ont.*

Others might insist on the use of 1¼-in. conduit. There would be no occasion to use No. 4 conductors since the 80% derating factor would not apply.

In addition to the foregoing, a separate ½-in. conduit would be required to serve the ½-hp. motor. From a standpoint of economy, it appears that the use of one 1¼-in. conduit is preferred. Other factors might dictate otherwise. The nature of the occupancy which appears to be a Class 2 hazardous area, and the desire to isolate one circuit from another could be considered when deciding the issue.—B.A.McD.—8/61/5

Conduit Fill

Q. *I would like your opinion in regard to my calculation for figuring the size of conduit for a motor circuit with the power and control conductors in the same conduit. It is a 7½-hp single-phase motor.*

2-*No.* 6 *motor conductors*

$2 \times 0.1238 = 0.2476$

3-*No.* 14 *control conductors*

$3 \times 0.0327 = 0.0981$

Total cross-section $= 0.3457$

40% *fill requires* 1¼-*in. conduit.*

Is this correct as 1-*in. conduit at* 40% *fill is* 0.34*? Would I be required to use the* 1¼-*in. conduit when it comes that close when I am using Type T conductors and the computation is done with the dimensions of Type R conductors as the code requires for new work?—R.B.*

A. According to the provisions of Section 346-6(a-2) of the code, the number of conductors permitted in a single conduit shall be as follows:

"(a) New Work-(2). Where conductors are of various sizes to be used in combination, use Tables 3 and 4 of Chapter 9 and the dimensions of rubber-covered conductors from Table 5 of Chapter 9."

Table 3 tells us that the number of conductors in a conduit or tubing, under the conditions described, should not exceed 40% of the area of the conduit. I say "should" since the note preceding Table No. 3 is phrased in the form of a recommendation.

Table 4 gives us the areas of conduit or tubing for the combinations of wires permitted in Table 3, Chapter 9. The note preceding this table is also phrased in the form of a recommendation.

It is quoted as follows:

"Tables 4 through 7, Chapter 9. Tables 4 through 7 give the nominal size of conductors and conduit or tubing (recommended) for use in computing size of conduit or tubing for various combinations of conductors. The dimensions represent average conditions only, and while variations will be found in dimensions of conductors and conduits of different manufacture, these variations will not affect the computation."

While the provisions of Section 346-6(a-2) definitely require a conduit fill to comply with Tables 3, 4 and 5, it is confusing when we find Tables 3 and 4 are merely recommendations. As a result, one might contend that there are no specific rules covering the problem presented by you. Insofar as code intent is concerned, I believe that the tables do cover your problem, and the foregoing comment as given with the thought that there is a question which needs code clarification.

On the basis of the Tables, your computations are correct. The total area of the conductors is 0.3457 sq in., and the 40% area of a 1-in. conduit is only 0.34 of a sq in. according to Table No. 4, or according to computation, 40% of 0.86 which is 0.344 sq in. In other words the deficit amounts to 0.3457 minus 0.344 which results in 17-thousands of a sq in. Is this of significant importance to warrant the use of 1¼-in. conduit? To me, the answer is no. It is also significant to note that the combination of conductors in question with Type T insulation could be installed in a ¾-in. conduit. This, of course is not permitted. The use of a 1¼-in. conduit, with Type R insulation would result in a 23% fill, and when Type T insulation is used, the fill would be as low as 14%.

The foregoing observations lead one to believe that the use of conduit as a wiring method is severely penalized by the code rule which does not recognize the Type T dimensions of conductors. Subject to conductor derating for room temperature and the number of conductors in a conduit, it appears that the time has arrived when a conduit fill should be based on the actual area of the conductor used. This would assure a more effective use of this wiring method.

A summary of the foregoing indicates to me that the notes preceding Tables 3 and 4 should be revised so that the status of the recommendation is clarified. It also appears that the note preceding Tables 4 through 7 should include the following advice.

"Decimals smaller than one hundredth of a square inch may be excluded from computations."—B.A.-McD.—8/61/6

Dry-Cleaning Equipment

Q. *I would like to know if any one has had any self-operated dry-cleaning machines installed in their localities?*

The machines are operated by the customer. They are not attended by anyone on duty. The machines use Perchlorethylene as the solvent. Are these machines listed by UL? Is there any hazard involved?—S.W.T.

A. Dry-cleaning equipment is listed by UL in two classifications. These classifications are based on the NFPA standards as set up in Standard No. 32, "Standard for Dry Cleaning Plants." Four classes are shown in the standard, each class being based on the type of solvent used in the system.

Class I systems are the most hazardous utilizing such solvents as ethyl alcohols, gasolines and ether. In general, these types of dry-cleaning plants are prohibited.

Class II systems use solvents similar to kerosene. These require special electrical equipment and wiring. In general, these types of plants are not available as self-operating units.

Class III systems are listed by UL in their Gas and Oil Equipment list. The solvents in this system are less hazardous than those in Class I and Class II.

Class IV systems are listed by UL in their Electrical Appliance and Utilization Equipment list. The solvents are listed as non-inflammable at ordinary temperatures and only slightly inflammable at higher temperatures.

This last Class IV system is the one used and approved for these self-operating dry-cleaning plants and machines. The equipment must be used only with the listed cleaning liquids classed as non-inflammable or as non-inflammable at ordinary temperatures and moderately flammable at higher temperatures and rated with respect to fire hazard at 5 and below. Each machine manufacturer lists the types of cleaning solvents to be used in his machines, and any change would endanger the safe operation of the system.

These systems are not investi-

gated by the UL for operation in hazardous locations. Therefore, they should not be installed in these hazardous locations. The systems require only the standard wiring methods approved by the code in Chapter 3.

It should be noted that most of the machines listed by UL in this Class IV are approved for use with the Dow Co. "Perchlorethylene" solvent.—B.Z.S.—8/61/7

NEC Official Interpretation

NFPA's National Electrical Code Committee has announced release of an official interpretation of the current NEC. The interpretation, effective June 23, 1961, was developed through normal committee procedure and has been reviewed and released by the Electrical Correlating Committee of the National Fire Protection Association.

Subject matter and text of the interpretation follow:

INTERPRETATION NO. 469

Subject—Proper installation, in a multi-family type dwelling, of a stationary domestic dishwasher incorporating a motor rated in excess of ¾ horsepower and a heater rated in excess of 300 volt-amperes.

Statement—A domestic dishwashing machine which incorporates a motor rated in excess of ¾ horsepower and a heater rated in excess of 300 volt-amperes, is installed as a stationary appliance in a multi-family type dwelling. The branch-circuit switch or circuit breaker is installed on another floor not within sight of the motor controller of the appliance, but is readily accessible to the user.

Question No. 1—If the branch-circuit switch or circuit-breaker is considered as providing the disconnect means required in Section 422-16, paragraph b, must it meet the requirements of Section 422-19?

Answer—Yes.

Question No. 2—Would the branch-circuit switch or circuit breaker be required to comply with the provisions of Section 430-102?

Answer—Yes.

Comment—If the unit switch provided as a part of the dishwasher were considered as the disconnect means, Section 422-17 (a) would apply.

They cost the same to run.

Compare a whole Volkswagen with half of an ordinary panel delivery.

The upkeep is almost the same.

VWs get 20 to 30 miles a gallon on gas, for instance. And about 35,000 miles on tires.

About twice as much as a conventional truck.

(A loaded VW is as light on its feet as other trucks empty. That's one of the reasons it costs so little to run.)

Also, a whole VW will cost no more to service than half of a standard truck. Owners tell us the VW has cut their repair bills around 50%.

(After all, we've been perfecting the same truck for 12 years.)

But half a truck won't carry the VW's 1,830 lbs.

This is only 170 lbs. less than a ton. Even if you put your standard half-ton back together, it wouldn't take it.

There is one advantage to cutting an ordinary truck in half. It will be easier to get into than a VW. But not much.

Our side doorway is almost 4 feet wide. And for $85* more, you can get another just like it on the other side.

But of course you wouldn't really cut a truck in half. People would point at you.

The real question is the upkeep of a whole truck. And you can run two Volkswagens for the same money.

Or just one and keep the difference. Some people can't think of anything but money.

Chicago Promotes Better Office Lighting

A coordinated electrical industry promotion is under way to modernize and upgrade office lighting in the Chicago area. The ultimate goal is to improve lighting conditions for an estimated 800,000 of 900,000 office employees who, surveys indicate, are working under inadequate lighting levels. The complete program was developed by a joint industry committee of the Electric Association of Chicago and the Chicago Lighting Institute.

Official announcement of this all-out drive was made at a kick-off luncheon at Chicago's new McCormick Place where some 300 electrical contractors, distributors and lighting manufacturers were given a run-down of the program. The luncheon signaled the opening of the Midwest Electrical Industry and Lighting Exposition sponsored by the Chicago Electric Association and the Electrical Maintenance Engineers.

Luncheon keynote speaker James F. Whitehead, Jr., president of Day-Brite Lighting, Inc., St. Louis, Mo., told the group that good lighting is industry's biggest bargain. Using national average figures to illustrate, he noted that of a $40 per sq ft per year office cost (including wages, equipment, services, space and lighting) only 25 cents has been allocated to lighting. Add only 50 cents for recommended lighting levels and the relative cost can be reduced through greater efficiency and operation, he revealed.

GOOD LIGHTING is industry's biggest bargain, keynoter J. F. Whitehead, president, Day-Brite Lighting, Inc., St. Louis, Mo., tells some 300 Chicago area electrical contractors, distributors and lighting manufacturers attending Office Lighting kickoff luncheon at McCormick Place. Luncheon preceded opening of Midwest Electrical Industry and Lighting Exposition.

APPLIED LIGHTING contestants in Commercial division at Sacramento lighting convention included (from left, front) B. A. Corwin, proxy for Don Rawlin, Arrowhead Chap.; Ray Dresser, Yosemite; Edward H. Peterson, San Jose; Les Van Nostrand and W. A. Stains, Mother Lode; Bill Jones, So. Calif.; Hunter Lauer, Diablo; Bruce Thyberg, San Diego, and Daniel Parenti, Golden Gate. Competition was won by Lauer with Jones and Thyberg placing second and third respectively.

As more is learned about the science of seeing, recommended footcandle levels have been increasing—from 10 in the 30's, 50 in the 50's to IES recommended 100 in the 60's. Projections of 200 to 500 footcandles for office lighting in the next two decades are not as fantastic as they might seem, he intimated.

Mr. Whitehead emphasized the need of salesmanship to promote the techniques and equipment developed by scientists and engineers. Best approach is to find your customer's needs, sell him the benefits of good lighting, keep your discussion simple so the customer can understand it, he noted as he elaborated on each point.

Chicago Program

Key to the Chicago program, as outlined by J. R. Walter, Westinghouse Electric Corp., and chairman of the promotion committee, is a six-lesson training course (one lesson per week) directed primarily to electrical contractors but open also to utility, distributor and lighting manufacturer personnel. Subjects covered include: Light and Lighting Terms; Developments in Light Sources and Auxiliary Equipment; Office Lighting; Illumination Design Methods; Office Lighting Applications; and Effective Sales Presentation.

Trainees who have completed a pilot course will form a pool of instructors for future courses to be given at Commonwealth Edison Company locations convenient to area groups of contractors.

Supplementing the training courses are the following promotional aids:

- An envelope stuffer to mail with monthly bills.
- Promotional pieces for separate mailing to prospect lists.
- Advertising in relevant local trade publications.
- Periodic publication of "Light Times"—a news bulletin of program activities.
- Office lighting displays at the Midwest Electrical Industry Exposition.

In addition to commercial lighting equipment displays at the Exposition, a Chicago Lighting Institute-Electric Association booth highlighted the advantages of good office lighting.

While the initial promotional effort is directed to better office lighting, other promotions are scheduled. Tentative plans call for similar programs to cover plant lighting, street and highway lighting and sports lighting.

The following Chicago electrical groups are cooperating in this initial all-out drive to modernize office lighting: lighting manufacturers, Midwest Electrical Distributors Association, Electrical Contractors Association of City of Chicago, Cook County Electrical Contractors Association, Chicago Lighting Institute, Electric Association of Chicago, Commonwealth Edison Co., and Public Service Co.

NYS Electrical Contractors Convene at Lake Placid

The New York State Association of Electrical Contractors and Dealers held their 62d annual convention at Whiteface Inn, Lake Placid, N. Y., July 2 to 8. Approximately 300 members and guests attended.

The theme of the convention was "The Electrical Industry—Key to Prosperity." Chairmen for the various sessions were A. L. Bush, president, Belmont Electric Company, New York, and chairman emeritus of the Board of Directors of the Association; H. A. Olson, vice president, General Electric Co., New York; and E. A. Brand, sales manager, Niagara Mohawk Power Corp., Buffalo.

M. J. Sherwood, director of Marketing Services, NECA, Washington, spoke on the NECA Sales Power Program. He said that the electrical contractor is the only representative of the industry who can offer the customer the ability to furnish, install and maintain the electrical facilities and equipment the user requires for his living or his business. He pointed out the need for contractors to get out and sell in order to make a better profit and remain in business.

A progress report on the activities of the New York Board of Fire Underwriters for the past eleven years since it took over the inspection responsibilities throughout the State for the fire insurance rating organization was given by E. C. Niver, executive vice president. He told of the growth of his organization's coverage throughout the State in cooperation with local governmental bodies, to extend protection to the customer and establish a minimum standard of electrical

CO-CHAIRMEN at Intermountain IES conference were Donald R. Dyrenforth and Wayne F. Mulcock.

YOU ASKED FOR IT—

the May 1960 feature section of Electrical Construction and Maintenance now in a handsome hard-cover book.

CONSTRUCTING ELECTRICAL SYSTEMS

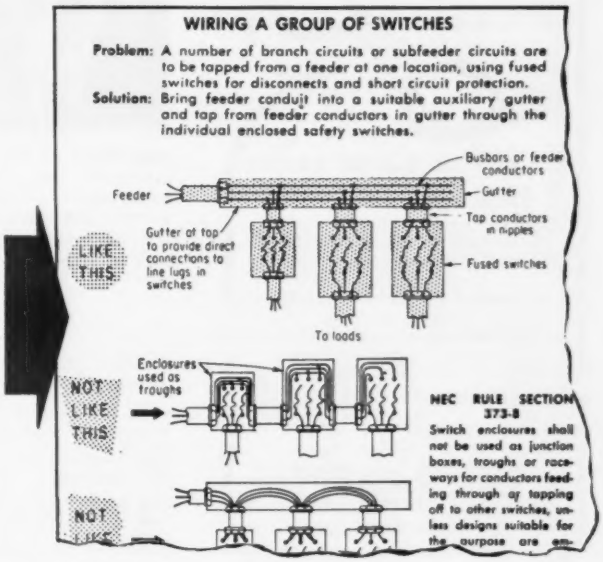
by J. F. McPartland and the Editors of Electrical Construction and Maintenance

Here's a modern, comprehensive reference and instruction manual on the methods and techniques used in constructing systems for power, light, signals and communications. Covering the best practice on selecting, mounting, connecting and housing all types of electrical equipment, **this manual presents *1959 National Electrical Code data* relating to installation. And a wealth of special illustrations are used throughout to clarify fine code points.**

Chapters are broken down on the basis of types of equipment to facilitate ready reference: lighting equipment – motors and controllers – conductors – raceways – switches – overcurrent protective devices – switchboards and panelboards – transformers – capacitors and regulators – power sources – high voltage – signals and communications.

CONTRACTORS – Get copies of this book for your job superintendents, foremen and estimators. They'll appreciate the gesture and you'll get a high return on your investment.

ENGINEERS – This book is a bonanza of information in the area where electrical design encounters most difficulty. Get copies for your key designers, junior engineers and draftsmen working into design.



PLANT ELECTRICAL PEOPLE – This book should be in the reference library of plant electrical engineers, electrical supervisors and electricians.

ELECTRICAL INSPECTORS – Here's a unique presentation of code rules in combination with specific installation details taken from modern practice. The correlation between code generalities and actual job specifics will assist inspectors in many difficult rulings.

CONTENTS

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(273-076)

PRESIDENT of San Francisco Electrical Contractors Assn., Emil J. Weber, compared regional design procedures with W. R. Grasle, Portland, past-president of NECA District 6, between sessions at recent tri-district meeting on the west coast.

specifications for the performance of work to the industry.

J. W. Frommer, president, L. K. Comstock Company, N. Y., and president of the Electrical League of New York, outlined the League activities. They included participation in National Electrical Week, a course in residential lighting in cooperation with the League of Lighting Arts, sponsorship of an Adequate Wiring booth at the Electrical Living Show at the New York City Coliseum, and a lighting course as set up by EEI.

"Relation of Industry Organization to Prosperity" was discussed by H. L. Weisman of New York, counsel to the Association and the New York Electrical Contractors Association. It is through the vehicle of organized associations that industry methods, standards and techniques are scrutinized, discussed and improved for all competitors, even non-members, he said. A trade association should be used to broaden its members' outlook and deepen individual friendships. This in itself tends to improve the standards of conduct and ethics of good business, all of which is related to the main object of business—to make a profit and to enjoy prosperity.

E. V. Gray, manager, Industrial Development, Long Island Lighting Co., Mineola, reported on area and industrial development in New York State. In cooperation with utilities, local governmental bodies, chambers of commerce and the New York State Department of Commerce, new businesses have been attracted to the State and existing industries have been given encouragement to expand and improve their plants.

"New York State's Tremendous Electric Power Resources—Present and Future" was discussed by W. D. Wilder, system supervisor, Power Control, Niagara Mohawk Power Corp., Syracuse. W. G. McKie, general sales manager, Rochester Gas and Electric Corp., presented the story of the total electric home, the way to better living. He stated that the utilities of New York State are spending the greater part of their promotional dollars in the development of the residential market.

R. F. Baldwin, president, Baldwin-Hall Company, Syracuse, told the audience that the expanding use of electrical energy and equipment in the next ten years will bring prosperity. The big question is—who will make a profit? He said that prosperity for the electrical industry can only be realized if the distributor, the contractor and the manufacturer take time to learn and understand each other's problems. If our industry is to expand to take care of the demands that will be made, we must grow and grow in the same proportion.

Our responsibilities as members of the electrical industry were discussed by A. J. Moore, manager, Northeastern Agency and Distributor Region, General Electric Co., New York. The electrical contractor has an unusually large number of basically favorable factors working in his behalf all the time. Among them are a continually expanding market and a progressively increasing share of that market; a persistent trend toward more and more electrification throughout industry; and in the home—automation, modernization and many others.

C. P. Clarke, manager, Headquarters Construction, Westinghouse Electric Corp., Pittsburgh, introduced new total electric frontiers, which are expected to become a reality within a decade. Mr. Clarke said "We have no comprehensive approach to the commercial market. It is time we stopped marching down the separate paths of product-oriented promotions; I know that now is the time to think total electric, and to sell total electric to our commercial customers. And I'm including apartments, schools, office and public buildings, along with all commercial buildings. There can be no question that we will benefit substantially in sales and profits for the industry.

"Some headway has already been made in selling commercial builders

and buyers on going total electric. Never in the history of this progressive industry has there ever been such a challenging frontier open to us. But to realize the full opportunities of this frontier, we must completely mobilize our resources, just as was done on the total electric home," Mr. Clarke concluded.

The following officers were reelected: H. F. Janick, Rochester, president; H. A. Webster, N. Y., first vice president; J. M. Smith, Cohoes, second vice president and secretary; R. J. Knoblock, Syracuse, treasurer; and J. P. O'Brien, financial secretary. E. G. May, Albany, and W. L. Drexler, N. Y., were reelected chairman and vice-chairman of the Board.

BLACKWELL RESEARCH data pertaining to recent studies of polarized light sources were authoritatively reported at recent IES meeting in Sacramento by Dr. H. R. Blackwell, Director, Institute for Research in Vision at Ohio State University. The Society's Technical Director C. L. Crouch (right) appeared on this same program.

N. Y. World's Fair Will Feature Lighting

Lighting design stands high in the planning program for the New York World's Fair 1964-65 which, in slightly less than three years, will open its gates to an expected 70 million visitors.

Full recognition of the important role that light will play in creating the after-dark mood of the exhibition has already been given by Robert Moses, the Fair's president.

A consultant group, with broad experience in dramatic and spectacular lighting, has been given the responsibility of creating the nighttime atmosphere of the Fair's public areas. The group will also design the many fountains which will be among the outstanding features of the Fair. Also, architects and designers of the exhibit buildings will develop their own exterior lighting —coordinating it with the over-all lighting concept of the public areas.

Consultants to the Fair are A. K. Morgan, J. S. Hamel, and Donald Oenslager, working in cooperation with the firms of Clarke and Rapuano, landscape architects and engi-

CONSTRUCTION PROBLEMS were analysed critically at NECA's tri-district western meeting in San Francisco by (left to right, seated): architect Charles R. Kahrs; electrical contractor Al Lera of Lemoge Electric; architect Richard S. Banwell, who also served as moderator, and (rear row, same order): Fred E. Wider, vice president, San Francisco Electrical Contractors Assn.; general contractor Bennett L. Raffin; session chairman Howard E. Bayley, Industrial Elec. Co., Seattle, vice president of NECA District 6; electrical engineer Glenn W. Smith, and electrical-mechanical engineer Thomas R. Simonson.

DEMONSTRATION of insulation was a feature of a shop tour of the Lubbock (Texas) Electric Co., during a recent meeting of EASA's Southwestern Chapter. At left is Southwestern Chapter President George Kinard, Electrical Machinery & Repair Co., Beaumont, Texas, with the demonstrator, Jack Floyd, Butts Electric Supply Co., Oklahoma City, Okla.; and Robert A. Renaud, Metals & Controls Division of Texas Instruments, Inc., Corpus Christi, Texas.

neers, and Hamel and Langer, lighting design consultants.

Mr. Morgan and Mr. Hamel were both associated with the New York World's Fair of 1939, and have been active in lighting design since that time—Mr. Morgan in the field of public parks and recreational areas, and Mr. Hamel as a consulting engineer. Mr. Oenslager is a well known theatrical scenic designer who has been active on the Broadway scene since 1930.

The magnitude of the design problems facing the groups is indicated by the size of the street and landscape lighting load, which is estimated at 7.5 million watts. It is also estimated that the fountains will be pumping more than 100,000 gallons of water per minute, and will use an additional 1.5 million watts for lighting.

EASA News

A big EASA event, the 4th Annual Chapter Officers' Conference, will be held in St. Louis in September, the exact dates and location to be announced. This meeting is attended by more than 60 presidents and secretaries of most of EASA's 36 chapters in the U. S. and Canada. Moderator will be Ben J. Horton, general manager, The Atkinson Armature Works, Pittsburg, Kansas, and EASA vice-president.

The Chapter Officers' Conference will be a two-day meeting, largely devoted to discussions of mutual association and industry problems. Also scheduled are talks on chapter leadership and publicity and on the association's management seminars and electronic motor control courses.

• • • •

EASA's 1963 Convention will be held in Dallas and the 1964 Convention will be held in New York at the time of the World's Fair.

Miss Marion Wassell, a San Franciscan since her retirement as EASA office manager in 1958, is putting her years of experience at EASA conventions to good use. At the recent EASA San Francisco Convention she returned to "active duty," and since has been working for other convention groups in the California city.

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EASA is still primarily a man's world, but an increasing number of women are invading its business meetings. For instance at the recent San Francisco convention, Mrs. F. M. Cannon, owner of Cannon Electric, Brookhaven, Miss., forsook the women's program of tours, luncheons and fashion shows to listen to talks about varnish, winding processes, equipment, management techniques, and the like. Mrs. Cannon's business was founded by her late husband and is currently managed by her son.

• • • •

Dr. Charles Orr, associate professor of economics at Roosevelt University, Chicago, a former representative of the United Nations International Labor Organization and advisor to India and several Far Eastern countries, discussed the effect of labor on the economy at the June 20 meeting of EASA's Chicago Chapter at Petricca's Restaurant.

A presentation of the testing of

CUTTING insulation paper is performed at the W. M. Smith Co., Lubbock, Texas, under the watchful eyes of Robert A. Young, Texas Bearing Co., Dallas, Texas; Carl D. Hogg, Crown Electric, Clovis, N. M.; and A. O. Kleen, Electrical Service Engineering Co., Austin, Texas, all of whom were attending a meeting in Lubbock of the Southwestern Chapter of EASA.

WHEN MEMBERS of EASA's Southwestern Chapter stopped at the W. M. Smith Co. shop in Lubbock, Texas, during a recent chapter meeting, they were welcomed by Mrs. Marie Merritt, secretary and bookkeeper of the company. Joining Mrs. Merritt for this picture were, from left: W. S. McCray, Helwig Carbon Brush Co., Houston, Texas; R. E. Clark, Brandon & Clark, Lubbock, Texas; William D. Dineen, Allis-Chalmers Manufacturing Co., Cincinnati, Ohio; and George T. Kinard, Electrical Machinery & Repair Co., Beaumont, Texas, president of Southwestern Chapter.

electronic armatures was given by J. W. Miller, district sales manager, National Electric Coil Co. Reports by chapter members who attended the San Francisco national EASA Convention were also presented. The Chicago group will be the host chapter to the 1962 EASA Convention, to be held at the Conrad Hilton Hotel, June 10-13.

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August A. Baechle, newly appointed EASA vice-president, was the guest speaker at a meeting of the Greater St. Louis Chapter of EASA on June 6 at Bel-Air Motor Hotel.

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Additional electronic motor control courses will be sponsored by EASA early next year, it has been announced by EASA headquarters. Dates will be announced in a few months. Meanwhile, association members have been lauding the courses that were held in Los Angeles, Oklahoma City, Minneapolis, Atlanta, Boston and Philadelphia early this year. More than 200 owners and employees of EASA member firms attended the week-long courses which consisted of intensive training in electronics and control equipment service. Consideration is also being given to an advanced course.

• • • •

Great Lakes Chapter held its June 26 meeting at Re-Nu Electric Co., Detroit. Hosts were Joseph Bilike, of the Re-Nu firm; Charles Villinger, of Armatures, Inc.; and Jerry Cohen, of J-C Electric Co.

Consolidation of several national committees of EASA by a special committee has reduced the total number of committees to a more workable group, it has been learned. An announcement of the new committees and their chairmen will be made next month.

New Books

Electrical Estimating, Third Edition, by Ray Ashley; 225 pages; $12.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y.

Newest revision is designed for the electrical contractor and estimator who wants to increase his business by more efficient management and understanding of his field. Practical methods, tips and guides are included to help streamline estimating procedures. Sample estimates, methods of checking estimates, and the preparation of labor-cost units are detailed; 25 tables of labor-cost units embrace more than 1800 individual items.

Farm Electric Sales Handbook, Revised Edition; loose-leaf notebook in binder; $3.50 to EEI members, $4.25 to non-members. Edison Electric Institute, 750 Third Ave., New York 17, N. Y.

Valuable to the farm electric salesman, electrical contractor or manufacturer for discussing electrical applications and their costs with farm customers. Partial contents include irrigation, shop, dairy, and brooding equipment. New chapters in this edition include electric motors, electric welding, emergency lighting, and livestock water warming.

SPEAKERS at the recently held IES East Central Regional Conference in Philadelphia included: John J. Neidhart, The Miller Co., Meriden, Conn., on "A Logical Approach to the Commercial Lighting Problem"; Robert T. Dorsey, Large Lamp Dept., General Electric Co., Nela Park, Cleveland, on "The Latest in Light Sources and Their Applications"; and George W. Clark, Lighting Fixtures Division, Sylvania Electric Products Inc., Wheeling, W. Va., on "High Intensity Industrial Lighting."

NEMA Accounting Manual Supplement, 15 pages, $1.50. National Electrical Manufacturers Assn., 155 E. 44th St., New York 17, N. Y.

Supplement to the seventh edition of the basic manual includes revision, updating and expansion of the parts dealing with accounting for depreciation, accounting for manufacturing costs, and financial and operating ratios. Included is a new section on methods of inventory valuation. The complete manual, which sells for $14.00, is adaptable to needs of all manufacturing industries, providing cost, tax and administrative information.

Lighting for Industry, 16 pages, 25 cents. Better Light Better Sight Bureau, 750 Third Ave., New York 17, N. Y.

Explains in non-technical language what's behind new higher recommended lighting levels, including list of footcandle levels, explanation of research program leading to the recommendations, discussion of quality factors in plant lighting, and ten illustrated case histories which paid off for the users.

Directory of Manufacturers' Representatives, Third Edition; 217 pages; $20. Manufacturers' Agent Publishing Co., 554 Fifth Ave., New York 36, N. Y.

Lists more than 15,000 manufacturers' domestic and export agents in the United States, Canada and Puerto Rico, arranged geographically with principal products carried and trading area covered. Included are prevailing commission scales and suggested contract forms.

Estimator's Heating, Plumbing and Air-Conditioning Manhour Manual, by John S. Page; $7.50. Gulf Publishing Co., P. O. Box 2608, Houston 1, Texas.

Gives scores of manhour tables with thousands of easy-to-use listings for estimating manhours in every phase of heating, air conditioning and ventilating, pointing out how to arrive at composite rates using productivity efficiency and production elements.

Transistor Substitution Handbook (Cat. No. SSH-1); 96 pages; $1.50. Technical Book Div., Howard W. Sams & Co., Inc., 2201 E. 46th St., Indianapolis 6, Ind.

Designed to minimize problem of selecting suitable transistor replacements in rapidly increasing number of industrial products now using this circuit element, listing over 6500 direct transistor substitutions and a separate directory of semiconductor diode and rectifier substitutions.

JUDGES for Applied Lighting contest at Salt Lake City included A. F. Wakefield, C. L. Crouch and Willard Allphin, all three men also appearing on that program as speakers.

Current Recommended Practice for Sports Lighting; 48 pages, 50 cents. (Special prices for quantities.) Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Covers lighting for sports ranging from major professional baseball and football games to recreational and playground activities such as horseshoe pitching and croquet, including spectator and player requirements, equipment, systems, and recommended layouts.

National Safety Congress Transactions on Electrical Equipment, 20 pages, 40 cents. National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

Three reprints of papers presented at the 48th National Safety Congress, including "Explosion-Proof Equipment," "Overcoming Explosion Hazards of Metallurgical Gases," and "Data Sheets for Electrical Equipment Safety."

NEMA Standards available from National Electrical Manufacturers Assn., 155 East 44th St., New York 17, N. Y.:

EI 20-1960: Watthour Meters ($1.35).

TR 71-1960: Removable Cable Terminating Boxes for Power Transformers (35¢).

TR 72-1960: Integral Cable Terminating Boxes for Power Transformers (35¢).

WD 2-1960: Wiring Devices (35¢).

PB 2-1960: Dead-Front Distribution Switchboards (25¢).

CP 1-1961: Shunt Capacitors (60¢).

IC 3-1961: Precision Snap-Acting Switches (35¢).

DATES AHEAD

International Association of Electrical Inspectors — Chapter Meetings — **Oregon,** Baseburg, Ore., August 12; **Northwestern Section,** Owyhee Hotel, Boise, Idaho, September 11-13; **Southwestern Section,** Lafayette Hotel, Long Beach, Calif., September 18-21; **Western Section,** Biltmore Hotel, Oklahoma City, Okla., September 25-27; **Eastern Section,** Warwick Hotel, Philadelphia, Pa., October 9-11; **Southern Section,** Grove Park Inn, Asheville, N. C., October 16-18.

National Assn. of Lighting Maintenance Contractors—National conference, Las Vegas, Nev., August 21-23.

Western Electronic Show and Convention—Cow Palace, San Francisco, Calif., August 22-25.

American Home Lighting Fixture Month—Sponsored by the American Home Lighting Institute, Chicago, Ill., September 1-30.

Rocky Mountain Electrical League—Fall Convention, Jackson Lake Lodge, Moran, Wyoming, September 10-13.

Industrial Electronics Symposium—Bradford Hotel, Boston, Mass., September 20-21.

Illuminating Engineering Society—National Technical Conference, Chase Park Plaza Hotel, St. Louis, Mo., September 24-29.

Industrial Building Exposition & Congress—New York Coliseum, New York, N. Y., September 25-28.

Third Virginia Biennial State-Wide Industrial Exposition—Victory Stadium, Roanoke, Va., September 27-30.

Florida Association of Electrical Contractors—Annual conference, Fort Harrison Hotel, Clearwater, Fla., September 29, 30—October 1.

Lighting Progress Exposition—Sponsored by the Electric League of Southern California, Hollywood Palladium, Los Angeles, Calif., October 3-5.

Delaware Valley Electrical Progress Show—Convention Hall, Philadelphia, Pa., October 3-5.

International Association of Electrical Leagues—25th Annual Conference, President Hotel, Atlantic City, N. J., October 4-6.

Western Building Industries Exposition—Great Western Exhibit Center, Los Angeles, Calif., October 7-10.

17th Annual National Electronics Conference — International Amphitheatre, Chicago, Ill., October 9-11.

National Electrical Contractors Association—Annual convention, Washington, D. C., October 9-14.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 13-17.

Electrical Engineering Exposition—Sponsored by AIEE, New York Coliseum, New York, N. Y., January 29-February 2, 1962.

Sixth National Electrical Industries Show — New York Coliseum, New York, N. Y., March 11-14.

Electrical Apparatus Service Association—Convention, Conrad-Hilton Hotel, Chicago, Ill., June 3-7.

ESTIMATING FORUM—XIII

[FROM PAGE 89]

Column "A" represents the upper extreme with reasons for the high values being:

1. The job absorbed too many indifferent mechanics.
2. All trades on the job were "letting down."

Column "C" represents the opposite extreme. The low values were recorded because:

1. Only men really interested in their work were employed.
2. All trades were giving their best and cooperating.
3. There was keen competition among mechanics for jobs.

Column "B" represents a list of suggested standards. It requires mechanics to be dressed and ready for work at 8:00 AM; provides ample time for the listed incidental activities; includes time for coffee-breaks. Contractor studies indicate that the 80 minutes suggested for incidental operations and coffee-breaks is ample.

In the electrical contracting industry there are more opinions than facts regarding manpower productivity. However, it is a combination of opinion and fact that keeps contractors alert and helps them avoid mistakes which impair productivity.

EMEA CONFERENCE co-chairman Bob Proctor of Larson-Hogue Electric Co., Los Angeles, (left) checks program notes with the Association's President O. D. Land, industrial engineer, and with banquet speaker George E. Kinney of Hughes Aircraft Co., who discussed "The Changing Face of Maintenance" with delegates to this meeting.

Among the Manufacturers

Headquarters Announcements

Pittsburgh Standard Conduit Co., Verona, Pa., has purchased the principal assets of the **Wagner Products Co.,** Decatur, Ill.

Reynolds Metals Co., Richmond, Va.—Gilbert R. Shockley, general director, Product Development Div.

Smithcraft Corp., Chelsea, Mass. —Dan E. Dunne, manager of marketing.

Benjamin Div., Thomas Industries Inc., Des Plaines, Ill.—Harry Shubart, director of manufacturing.

Champion Lamp Works, Lynn, Mass.—Willard S. Ferris, general sales manager.

Morrison Steel Products, Inc., Buffalo, N. Y.—M. Jacque Kohnstamm, president.

Sylvania Electric Products Inc., New York, N. Y.—Robert S. Rogers, manager, National Accounts, Large Lamp Products, Lighting Products Div.

Chromalox, Inc., Murfreesboro, Tenn.—Frank B. Knight, vice president; G. Edward Ammerman, general sales manager.

Advance Transformer Co., Chicago, Ill.—Max D. Orr, executive vice president; William Weber, Jr., director of manufacturing.

General Electric Co., Schenectady, N. Y.—Dr. A. Eugene Schubert, general manager, Power Transformer Dept., Pittsfield, Mass; A. W. Warren, manager of manufacturing administration, Service Shops Dept.

Luminous Ceilings, Inc., Chicago, Ill.—Robert Jones, president of newly formed division—Luminous Ceilings West Inc. located in Los Angeles, Calif.

Sloan Co., Sun Valley, Calif. —Gene H. White, marketing director and sales manager, Color-Lite Div.

American Kloeckner-Moeller Corp., Tulsa, Okla.—Byron R. Stratton, national sales manager.

Gould-National Batteries, Inc., St. Paul, Minn.—E. I. Whyatt, vice president of administration.

Blackhawk Industrial Products Co., Butler, Wis.—Paul Moore, manager, EnerPac Div.

Joy Manufacturing Co., St. Louis, Mo.—W. Charles Brandenburg, manager of mining sales, Electrical Products Div.

Electric Storage Battery Co., Philadelphia, Pa.—W. W. Gould, nickel-iron battery market manager, Exide's Industrial Marketing Div.

General Precision, Inc., Tarrytown, N. Y.—Robert L. Rice, vice president for industrial marketing; also director of industrial marketing for parent corporation, General Precision Equipment Corp.

International Rectifier Corp., El Segundo, Calif.—Paul J. Colleran, vice president of engineering.

Union Metal Manufacturing Co., Canton, Ohio—Calvin Friar, manager of outdoor lighting products.

Porter-Cable Machine Co., Syracuse, N. Y.—Charles R. Stelljes, manager of engineering and research, Portable Tool Div.

Western Insulated Wire Co., Los Angeles, Calif.—Jack Stumph, general sales manager of Bronco products; George Hunsinger, chief engineer.

Stanley Works, New Britain, Conn.—Bennett Lord, manager, industrial hardware, Hardware Div.

Olin Mathieson Chemical Corp., New York, N. Y.—Fred H. Edgar, vice president of aluminum sales, Metals Div.

American Super-Temperature Wires, Inc., Winooski, Vt.—John J. Mancino, vice president and general manager.

Westinghouse Electric Corp., Pittsburgh, Pa.—Dr. Patrick Conley, vice president of industry engineering apparatus, service and newly created industry systems department.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Charles F. O'Riordan, general manager, Defense Products Div.; Charles W. Parker, Jr., general marketing manager, New Products Dept.; R. E. Horn, manager, J. F. Kulas, manager of sales, and A. H. Baguhn, chief engineer, Regulator Dept.; Ted Merkel, application engineer, Pump Dept.

Skil Corp., Chicago, Ill.—L. L. Stuart, service operations manager.

Volkswagen of America, Englewood Cliffs, N. J.—Henry J. Harman, special truck sales representative.

Regional Appointments

NEW ENGLAND

Bishop Manufacturing Corp.: Carter-Danek Co., Wellesley Hills, Mass., manufacturer's representative for New England area.

I-T-E Circuit Breaker Co.: Richard L. Masterson, manager of New Haven district office, Commercial Apparatus Group.

General Electric Co.: Dean N. Jenks, manager of the New England sales district, Newton Upper Falls, Mass.

MIDDLE ATLANTIC

Marvin Electric Mfg. Co.: Bert Wayne, representative in the New York-New Jersey area.

Thomas Industries Inc.: Robert J. Griffin, sales representative with headquarters in Albany, N. Y., Lighting Div.

H. K. Porter Co., Inc.: E. J. Campbell, branch manager, Buffalo, N. Y., National Electric Div.

C & D Batteries, Div. The Electric Autolite Co.: Irving T. Bartlett, Jr., manager of New York office.

SOUTH ATLANTIC

Allen-Stevens Conduit Fittings Corp.: J. T. Fulwiler, Jr., Atlanta, Ga., sales representative for Georgia, Tennessee and Alabama.

General Blower Co.: Allen-Mitchell & Co., Washington, D. C., sales representative.

Morrison Steel Products, Inc.: Harry Short, Baltimore, sales representative for Delaware, Maryland and District of Columbia, Roly-Door and Roly-House Divisions.

Wakefield Lighting Div.: Hamer K. Spencer, sales representative for Virginia, offices in Portsmouth; Richard Y. Fernandez, sales representative for Tampa, St. Petersburg and Sarasota, Fla., with offices in Madeira Beach.

I-T-E Circuit Breaker Co.: Albert L. Folden, manager of Atlanta district office, Commercial Apparatus Group.

General Electric Co.: Ralph E. Crockett, manager of Virginia sales district, Richmond, Va.

Thomas Industries Inc.: Gilbert W. Allen, district sales engineer at Charlotte, N. C., Lighting Div.

EAST CENTRAL

Morrison Steel Products, Inc.: Melville C. Knirsch, midwest sales manager, Chicago, Ill.

Allis-Chalmers Mfg. Co.: Joseph M. Duncan, manager of North Central region with headquarters in Chicago; Industries Group.

Ilg Electric Ventilating Co.: Everett Chappell, sales representative in Jackson, Miss.

Taylor Fibre Co.: William J. Koness, manager of Detroit sales district.

Bell Electric Co.: Herbert Lewin, Midwest sales representative for Chicago, northern Illinois and Wisconsin.

Black and Decker Mfg. Co.: C. Vernon Allen, sales representative in the Indianapolis-Fort Wayne area, Consumer Products Div.; J. Harold Taylor, branch service manager of new Grand Rapids, Mich., location.

Edwards Co., Inc.: James S. Petrolino, central district manager at Chicago.

H. K. Porter Co., Inc.: W. D. McGaffic, Chicago branch manager, National Electric Div.

Wheelock Signals, Inc.: M. J. Gorrie & Associates, Birmingham, Ala., sales representatives.

Luxo Lamp Corp.: John S. Sprenger, manager of new Chicago office.

Thomas Industries Inc.: Clifford W. Kuhlman, sales representative at Birmingham, Ala.; Roy E. Lemley, sales representative at Columbus, Ohio; Lighting Div.

Western Insulated Wire Co.: Thomas J. Walsh, Bronco midwest regional manager, headquarters in Chicago.

WEST CENTRAL

Allen-Stevens Conduit Fittings Corp.: Wayne G. Parker, Jenks, Okla., sales representative for Oklahoma and Arkansas; Weilbaecher & Kennedy, New Orleans, La., sales representative for Mississippi and Louisiana; Jack P. Morgan, Dallas, Texas, sales representative for Texas.

Owatonna Tool Co.: D. B. Hawkinson, district manager for eastern Kansas and western Missouri.

WEST

Allen-Stevens Conduit Fittings Corp.: Don Steinkamp, Denver, Colo., sales representative for Colorado and Wyoming; Sam Gamson, Beverly Hills, Calif., sales representative for southern California, Arizona and El Paso, Texas.

Western Insulated Wire Co.: Frank J. Furnell, Bronco Pacific Coast regional manager, headquarters in Los Angeles.

Murray Mfg. Co.: John S. Payne, western regional manager, Los Angeles.

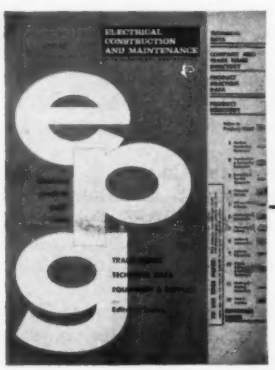
H. K. Porter Co.: J. C. Maeder, western district manager, headquarters at Los Angeles branch; W. J. McMillan, Los Angeles branch manager; National Electric Div.

Wheelock Signals, Inc.: R. E. Cathey Co., Denver, Colo., sales representative.

Advertising In This Issue

■

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.



• These manufacturers advertised their products in the ELECTRICAL PRODUCTS GUIDE ISSUE

For more complete information, and application data on their lines, refer to the index of Advertisers in the ELECTRICAL PRODUCTS GUIDE . . . the 13th issue of ELECTRICAL CONSTRUCTION AND MAINTENANCE.

Whether I Buy Assembled Fuse Boxes or *"Plug-In"* Components

I'M MONEY AHEAD WITH SQUARE D SERVICE EQUIPMENT

SAVES MATERIAL

Compact interior arrangement saves up to 22 feet of branch wire and at least one foot of service cable.

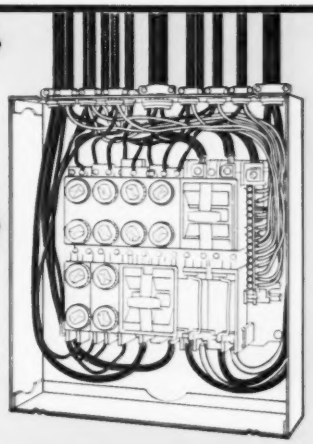
All line lugs approved for both copper and money-saving aluminum.

SAVES TIME

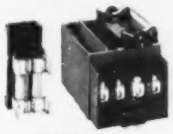
Extra-wide boxes—plenty of room to take ALL circuits in and out of either top or bottom endwall.

All split bus lighting circuits are prebussed. No wires to connect.

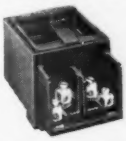
Box lugs for easy wiring on ALL load side connections. No washer head screws.



NEW COST-SAVING COMPONENTS

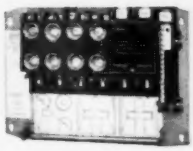


TANDEM PULL-OUT provides two 30 amp, 240V circuits in one plug-in unit



WATER HEATER PULL-OUT No need to mount separate water heater disconnect

DELTA PULL-OUT 3φ branches in low cost 1φ load centers



150 AMP INTERIOR for popular size homes

Extra Benefits of Off-the-Shelf Components

YOU START WITH 3 BOXES • That's all you need, in stock or on the truck, to rough-in any 100-200 amp service. No money tied up in interiors until the job is ready to be finished.

YOU GET INTERIORS LATER • No on-the-job damage because interiors are bought and installed after rough-in work is completed. Plug-in space offers flexibility. Add circuits required, leave space for the future.

PLUG-IN UNITS GIVE YOU FLEXIBILITY • Wide range of units available—120V twin plug fuse unit; 240V tandem 30 amp pull-outs; 240V, 30 and 60 amp single pull-outs; water heater and Delta pull-outs. Last minute changes or additions can't upset your wiring plans. Factory-assembled devices of FSP components also available.

Square D Company, Mercer Road, Lexington, Kentucky

SQUARE D COMPANY

wherever electricity is distributed and controlled

CROUSE-HINDS ARK-trol

ELECTRICAL CONNECTORS

deliver normal operation . . . under abnormally severe conditions!

Very little can impair the reliability of an ARK-trol Connector . . . short of malicious mischief. Even that takes some doing!

Basic aluminum alloy components of the ARK-trol are high strength impact extrusions . . . anodic coated to resist corrosion . . . tough enough to withstand vibrations up to 20G's, or shocks up to 50G's without impairment of performance. Temperature limits range from −65°F. to +350°F. constant. **And,** in addition, ARK-trol is circuit-breaking under full load.

NEMA Ratings for other environmental factors:

CLASS	DEFINITION	CONDITION
1 & 12	Industrial Use	Excludes dust, lint, fibres, flyings, oil or coolant seepage.
2	Moisture Resistant	Materials are unaffected by condensation.
3 & 3R	Raintight & Splashproof	Outdoor areas.
4	Watertight	Excludes water by hose spray or impingement.
5 & 13	Dust-Tight	Excludes dust, but performs normally if dust is accidently enclosed during disconnect.
6	Submersible	Performs normally when submerged in water.

ARK-trol Electrical Connectors are U.L. listed and conform to J.I.C. Standard.

REDUCED SIZE and WEIGHT: PLUG and RECEPTACLE			
SIZES	RATINGS	WEIGHT	DIMENSIONS
017	20-30 Amps.	16 oz.	7⅜" long x 1.630" dia.
021	20-30 Amps.	20 oz.	7⅜" long x 1.630" dia.
033	30-100 Amps.	40 oz.	9⅞" long x 2.685" dia.
041	100-200 Amps.	65 oz.	10⅜" long x 3.190" dia.

INSERT and CONTACT FEATURES

- **Interiors are reversible and interchangeable.**
- **Four alternate polarizations (5 total).**
- **Available with or without provision for grounding.**
- **Contacts are removable.**
- **Crimp, solder or pressure terminations.**
- **One to 100 contact possibilities.**
- **Contact sizes: 16, 12, 10, 4, 1/0, and 4/0.**
- **Three types of cord grip: standard, mechanical and wire mesh.**

Write for Bulletin 2711 containing complete descriptions, specifications and configuration patterns.

CROUSE-HINDS

REG. U. S. PAT. OFF.

Syracuse, New York USA

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